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NEW CONCEPTIONS OF SPECIES AND GENERA, AND OF CLASSIFICATION, DISCOVERED IN THE EVOLUTION OF THE TITANOTHERES[1]

BY HENRY FAIRFIELD OSBORN

It is interesting to observe the bearing of palaeontology on the development of various branches of biology, especially upon the science of mammalogy.

Osborn began intensive palaeontological research in the year 1890. In June, 1900, he succeeded Marsh in the United States Geological Survey and at once began a most intensive geological, anatomical, and biological research on the evolution of the family of odd-toed ungulates, known as Titanotheres, from a name applied by Joseph Leidy to the jaw bone of *Menodus*, discovered in 1846. The monograph[2] covered twenty-nine years of research and exploration in New Mexico, Colorado, Utah, Wyoming, South Dakota, Montana, the Gobi Desert, Burma, and the Balkans. The evolution of the titanothere heredity germ was followed over a period estimated by geologists at ten million years, beginning with the *Ectitanops*, only a few inches in height, and ending with *Brontops*. Comparison is made with the family tree of the odd-toed ungulates known as Perissodactyls, showing the adaptive radiation of nine families and thirty-five sub-families as compared with the Titanotheres which, within a single family, include twelve

[1] Presented at the Twelfth Annual Stated Meeting of the American Society of Mammalogists, American Museum of Natural History, May 21, 1930.

[2] Osborn, Henry Fairfield: "The Titanotheres of Ancient Wyoming, Dakota and Nebraska." United States Geological Survey, Monograph 55. Washington, D. C., 1929.

sub-families, twenty-six genera, and one hundred and six species, many of which are arrayed in close phylogenetic order.

This affords an unprecedented opportunity to contrast the zoological concept of Linnaeus of contemporaneous species with the modern palaeontological concept of the origin of species, sub-families and families, observed in close detail through long periods of time. With the aid of very able colleagues, such as William K. Gregory, each minute part of many organs has been examined and precisely measured from its origin in the germ plasm to its increasing importance into what may become an absolutely dominating character of the organism. This progression or retrogression is absolutely continuous and invariably definite and determinate rather than fortuitous. Characters rise and fall under thirteen principles, four of which have been absolutely confirmed in the course of preparation of this monograph. The close analysis of thousands of separate characters gives us an entirely new concept of the origin of what has been called in palaeontology the "ascending mutation"[3] of a species and genus. The concept first put forward by Waagen in 1869 is that such mutations are so inconspicuous that we would not notice them were it not for their more distinct appearance in the next higher geological step.

Inasmuch as every single one of the thousands of characters in the dental and skeletal mechanism is independently evolving, although constantly interrelated with all the other characters, *a species is defined by one or more characters which reach a conspicuous stage either of progression or of retrogression.* This is as true of palaeontologic as of zoologic species, although in the latter case our definition is according to the eyes of Linnaeus and of Darwin, whereas in this palaeontologic monograph we trace back to their origin the inconspicuous antecedents of each specific character.

Characters of two kinds. It happens in the odd-toed ungulates, such as horses, rhinoceroses and Titanotheres, as well as in all other fossil mammals, that conspicuous characters mostly are of two kinds: first, *allometrons*, or changes of proportion, such as are seen in the changes of proportion of the skull and in the reproduction or enlargement of parts of the limbs; second, *rectigradations*, adaptively arising as new characters. In Miller's splendid work, "Mammals of Western Europe," can be found all the species defined by what may be called either "recti-

[3] This term of Waagen refers to the continuous progressive movement in a single character and is quite distinct from the sudden saltatory "mutations" of DeVries.

gradations" or "allometrons," that is, either by single characters or by changes of proportion. Also, Leidy, Cope and Marsh independently divided Eocene and Miocene horses by their successive "rectigradations" or "allometrons."

Characters of different velocities. In the Titanotheres we enjoy an unparalleled opportunity of discovery that *a genus consists not only of its visible generic characters but of invisible potential characters in the germ which may lie dormant for hundreds or thousands of years until they emerge.* Moreover, each genus is characterized by different rates or velocities in the progression or retrogression of the thousands of characters which are embraced in its hereditary germ. We see this illustrated for example in the horns of mammals; a horn is a rectigradation. The horn and teeth rectigradations are hurried forward in one generic or sub-family phylum, while they are closely guarded within the germ plasm of another generic or sub-family line dwelling in the same geographic region. These origins of rectigradations are controlled by ancestral or potential heredity, whereas the origins of allometrons or changes of proportion respond directly to adaptive changes in environment.

Thus it may be claimed without exaggeration that the Titanothere Monograph solves all the principles of all the hard parts involved in the origin of "ascending mutations" of species, of genera, of sub-families, and so forth. There is a firm and undeviating orthogenetic order in the entire animal mechanism, but the underlying causes of this order are only partly known.

The above is a very concise and condensed statement of changes which are illustrated in great detail in the Monograph, not only as they occur among Titanotheres but among other quadrupeds, both odd-toed and even-toed.

As shown graphically in illustrations in the Monograph, the family tree of the Titanotheres runs over a period estimated at 10,000,000 years, beginning with *Lambdotherium*, progressing into *Eotitanops* and finally into *Brontops*, and then branching out. These facts were obscure until twenty-one geologic life zones of lower Tertiary time were specifically and remarkably analyzed by Dr. William D. Matthew, aided by Walter Granger, through Osborn's work on a group with which he was especially familiar. Through Dr. William K. Gregory's skillful analysis of the musculature of *Brontops robustus*—a research of three or four years' length—the late Erwin Christman succeeded in producing

a marvelous restoration of this animal, giving us the first complete musculature of an extinct mammal.

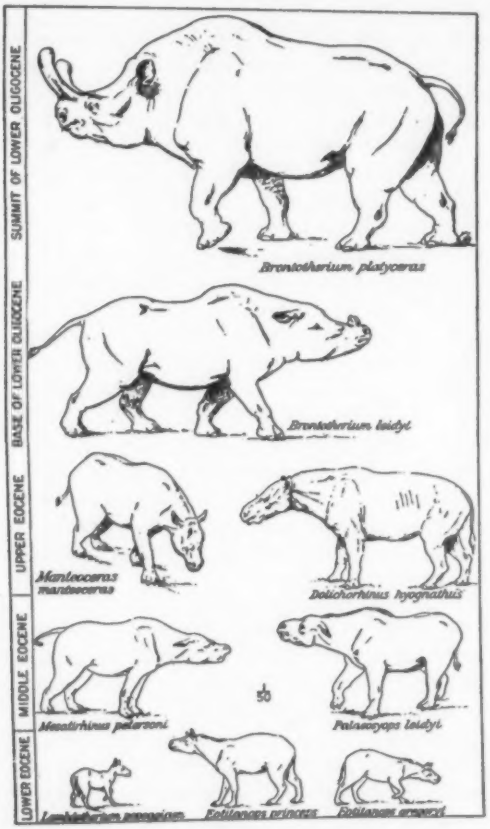


FIG. 1. RESTORATIONS OF NINE SPECIES OF TITANOTHERES FROM THE LOWER, MIDDLE AND UPPER EOCENE AND THE LOWER OLIGOCENE

Drawn by Mrs. E. M. Fulda. About one-fiftieth natural size

Osborn's analysis of the family tree of the Perissodactyls, or odd-toed ungulates, illustrates the principle of "adaptive radiation" and of "paral-

lelism" in foot and dental structures brought about by similarity in environment. The Perissodactyls are divided into "cursorial," "forest-

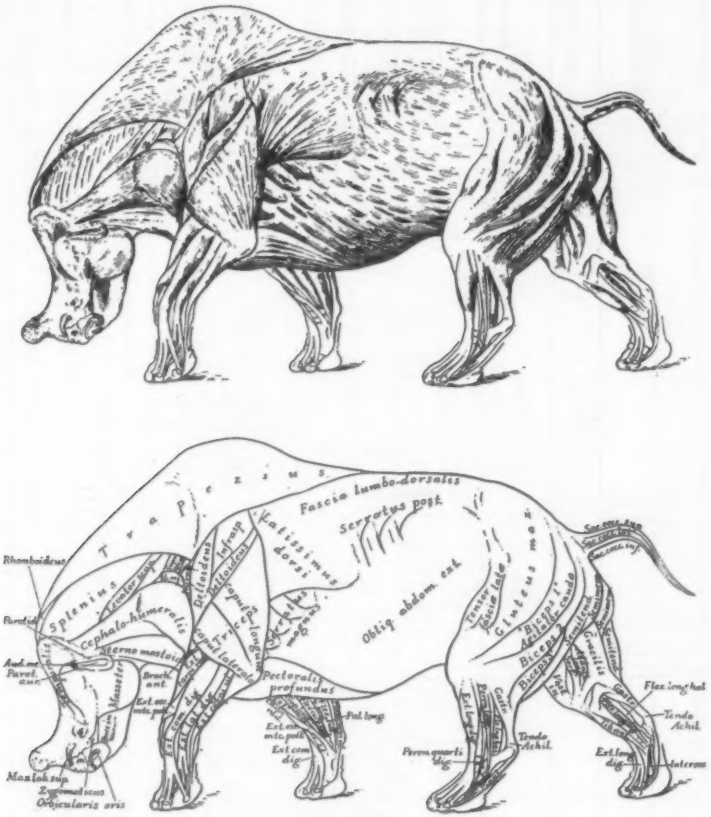


FIG. 2. RESTORATION OF THE SUPERFICIAL MUSCLES OF THE BODY OF AN OLIGOCENE TITANOTHERE (BRONTOPS CF. B. ROBUSTUS) AFTER THE REMOVAL OF THE PANNICULUS

Drawn by Erwin S. Christman. About one twenty-fifth natural size

living," "aquatic," "mediportal" and "graviportal" types, all of which assume similar characters under the law of parallelism, although they

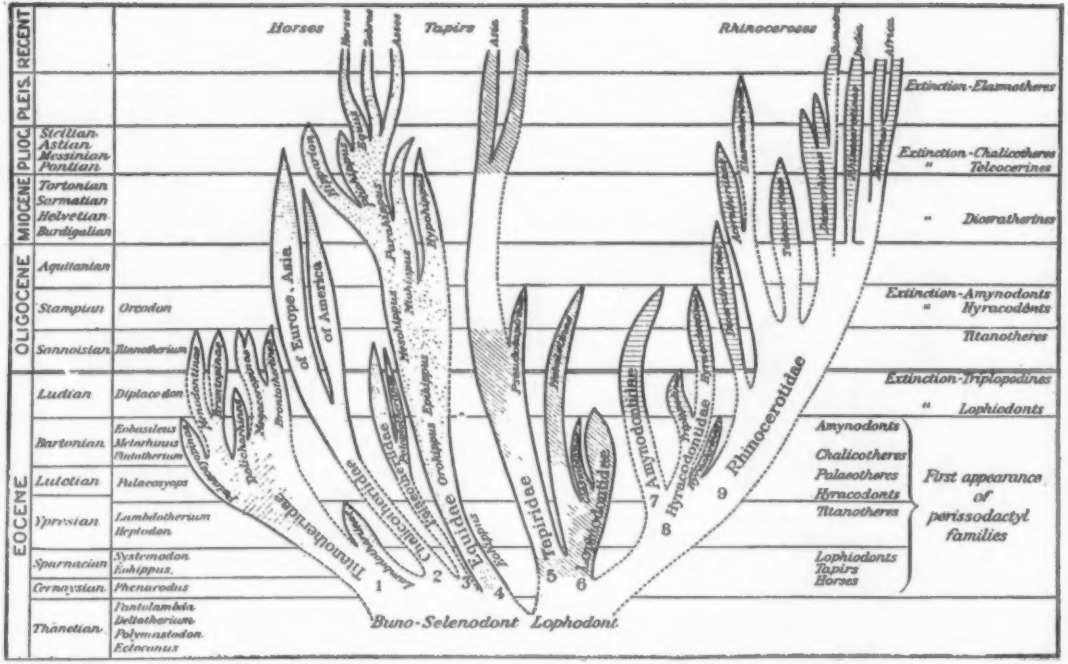


FIG. 3. THE FAMILY TREE OF THE PERISSODACTYLA. SUCCESSIVE APPEARANCE IN LATITUDE 40° OF REPRESENTATIVES OF THE NINE FAMILIES. SUCCESSIVE EXTINCTION OF SIX FAMILIES. SURVIVAL OF THE THREE EXISTING FAMILIES—THE HORSES, TAPIRS, AND RHINOCEROSES

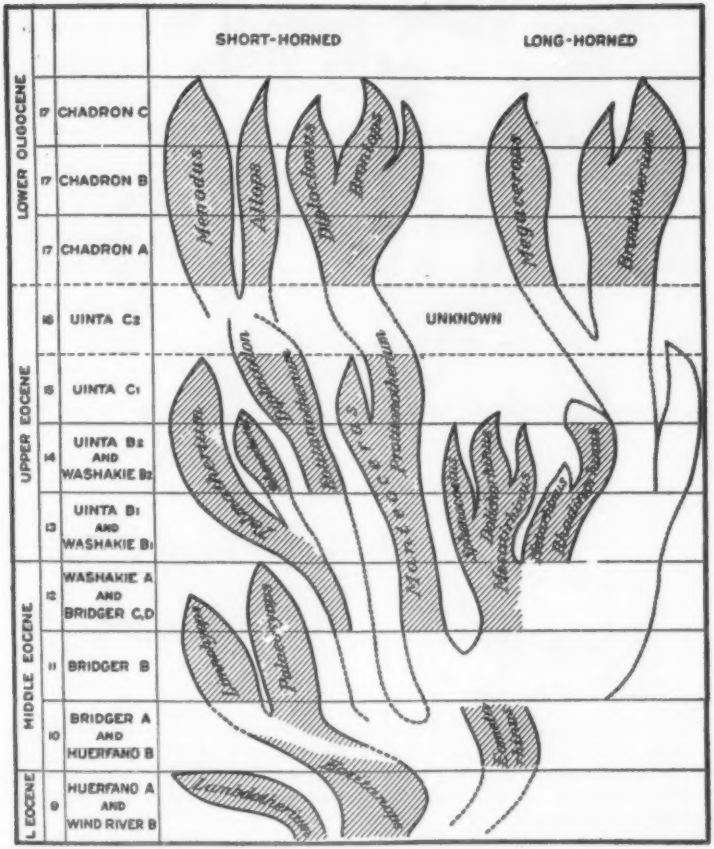


FIG. 4. THE FAMILY TREE OF THE TITANOTHERES, SHOWING THE RELATION BETWEEN THE BRANCHES (PHYLA), SUB-FAMILIES, AND GENERA, AS KNOWN TO SCIENCE IN 1919. THE SHADED AREAS SHOW CONNECTIONS THAT ARE WELL ESTABLISHED; THE DOTTED LINES SHOW GAPS THAT REMAIN TO BE FILLED BY FUTURE DISCOVERY, ESPECIALLY IN THE UINTA FORMATION OF UTAH

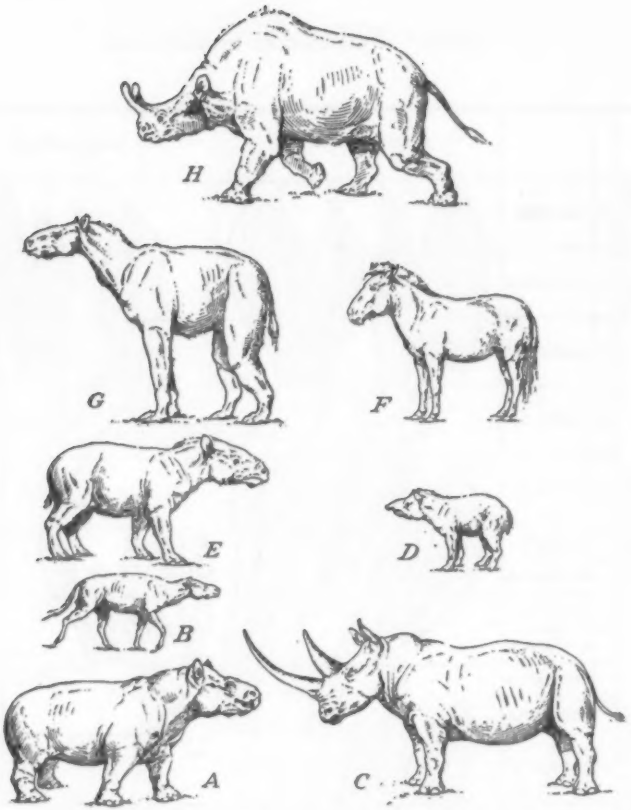


FIG. 5. OUTLINES OF THE BODY FORM OF THE PERISSODACTYLS, DRAWN TO THE SAME SCALE. THE LARGEST KNOWN MEMBER OF EACH FAMILY IS SELECTED FOR COMPARISON. THE ANIMALS ARE GROUPED ACCORDING TO THEIR NATURAL RELATIONSHIPS, AS INDICATED ESPECIALLY BY THE PATTERN OF THE MOLAR TEETH, AS FOLLOWS:

RHINOCEROTOID GROUP: *A*, *Metamynodon*; FAMILY AMYNODONTIDAE; GRAVIPORTAL; AQUATIC; LOWER OLIGOCENE. *B*, *Hyracodon*, FAMILY HYRACODONTIDAE; CURSORIAL; MIDDLE OLIGOCENE. *C*, *Ceratotherium simum*; LIVING WHITE RHINOCEROS; FAMILY RHINOCEROTIDAE; GRAVIPORTAL

TAPIROID GROUP: *D*, *Tapirus terrestris*; EXISTING TAPIR; FAMILY TAPIRIDAE; MEDIPORTAL

HIPPOID GROUP: *E*, *Palaeotherium*; FAMILY PALAEOTHERIIDAE; LOWER EOCENE; MEDIPORTAL. *F*, *Equus przewalskii*; EXISTING HORSE; FAMILY EQUIDAE; CURSORIAL

CHALICOTHEROID GROUP: *G*, *Moropus*; FAMILY CHALICOTHERIIDAE; CLAWED PERISSODACTYL; LOWER MIOCENE

TITANOTHEROID GROUP: *H*, *Brontotherium platyceras*; FAMILY BRONTOTHERIIDAE; GRAVIPORTAL; LOWER OLIGOCENE

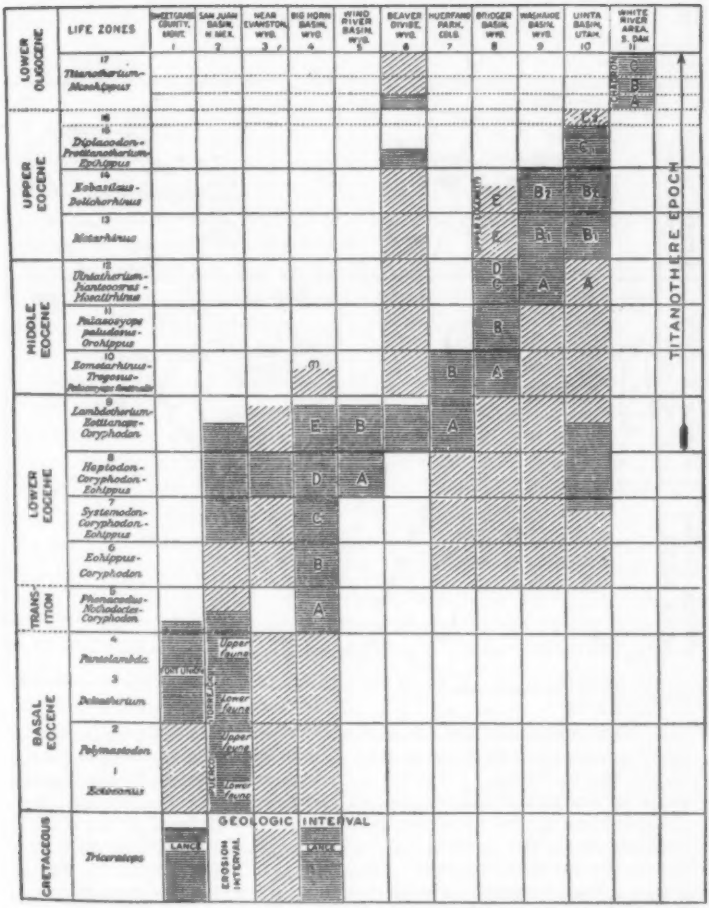


FIG. 6. EOCENE AND LOWER OLIGOCENE MAMMALIAN LIFE ZONES IN ELEVEN TYPICAL CORRELATED AREAS IN NEW MEXICO, COLORADO, UTAH, WYOMING, SOUTH DAKOTA, AND MONTANA. ARRANGED BY OSBORN (1919) AFTER ORIGINAL STUDIES MADE IN THE FIELD, CHIEFLY BY GRANGER, BUT ALSO BY HATCHER (OLIGOCENE), HILLS, PETERSON, AND GIDLEY (EOCENE). THE 16 KNOWN LIFE ZONES NUMBERED 1 TO 15 AND 17 ARE INDICATED IN THE DIAGRAM BY DARK HORIZONTAL LINES. THE NONFOSSILIFEROUS AREAS ARE INDICATED BY LIGHT OBLIQUE LINES. THE UNITED STATES GEOLOGICAL SURVEY CLASSIFIES THE LANCE FORMATION AS TERTIARY (?), EOCENE (?). THE AUTHOR REGARDS IT AS CRETACEOUS

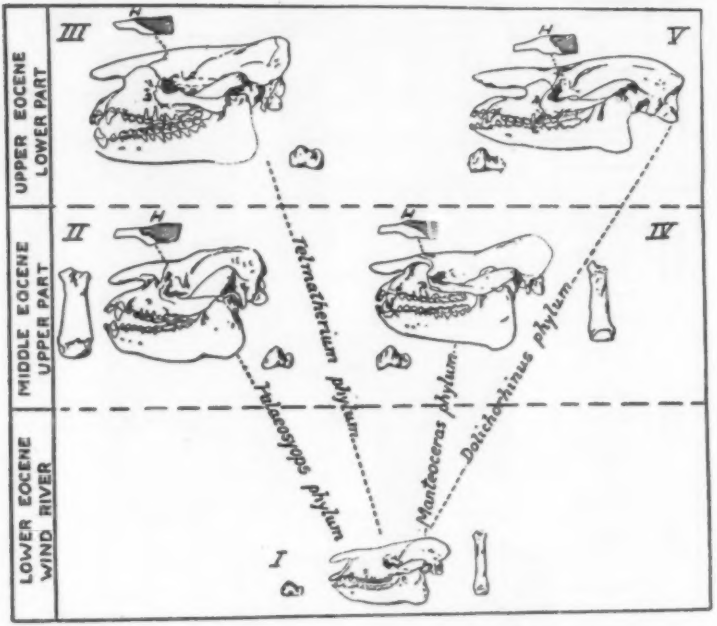


FIG. 7. RECTIGRADATIONS AND ALLOMETRONS IN THE SKULLS, TEETH, AND FEET OF TITANOTHERES. RECTIGRADATIONS ARE SHOWN ON THE CUSPULES OF THE LOWER SECOND PREMOLAR TEETH; ALLOMETRONS ARE SHOWN IN THE PROPORTIONS OF THE HEAD (BRACHYCEPHALIC, MESATICEPHALIC, DOLICHOCEPHALIC); ALLOMETRONS ARE SHOWN IN THE PROPORTIONS OF THE MEDIAN METACARPAL (DOLICHOPODAL, MESATIPODAL, BRACHYPODAL). I, *Eotitanops*, AN ANCESTRAL LOWER EOCENE MESATICEPHALIC, DOLICHOPODAL TITANOTHERE; II, *Palaeosyops*, A BROAD-HEADED (BRACHYCEPHALIC), BROAD-FOOTED (BRACHYPODAL) UPPER MIDDLE EOCENE TITANOTHERE; III, *Telmatherium*, A MEDIUM-HEADED (MESATICEPHALIC) UPPER EOCENE TITANOTHERE; IV, *Manteoceras*, A MEDIUM-HEADED (MESATICEPHALIC), MEDIUM-FOOTED (MESATIPODAL), MIDDLE EOCENE TITANOTHERE; V, *Dolichorhinus*, A LONG-HEADED (DOLICHOCEPHALIC) SHORT-FOOTED (BRACHYPODAL) UPPER EOCENE TITANOTHERE. II–V REPRESENT FOUR INDEPENDENT PHYLA OF EOCENE TITANOTHERES WHICH ARE WIDELY DIVERGENT IN THE ALLOMETRIC EVOLUTION OF THE HEAD AND OF THE FEET BUT ARE CONVERGENT IN THE INDEPENDENT EVOLUTION OF SIMILAR CUSP RECTIGRADATIONS ON THE TEETH AND SIMILAR HORN RUDIMENTS (H) ON THE SKULL

are descended from different ancestors. This family tree, when worked out with a greater degree of fineness, demonstrates that the Titanotheres are simply an early episode in the evolution of this great order, and that the maximum adaptive radiation of Perissodactyls occurred at the close of Oligocene time, and was followed by the extinction of numerous types and by the survival of only the three great existing types—the rhinoceros, the tapir and the horse.

Our knowledge of the external appearance and character of the Titanotheres is illustrated in the long-headed type, the *Dolichorhinus*, the relatively primitive horn-tipped *Manteoceras*, and the broad-headed type, *Palaeosyops*, constituting three separate generic phyla, all including a number of ascending types of species. *Dolichorhinus* presents a contrast to its ancestor, *Mesatirhinus*. Every line of Titanotheres originates with a form very much of the type of *Eotitanops*, in which the face and cranium are equal in length. There are many illustrations of rectigradations; from a hornless ancestor appear horned descendants, arising independently in entirely different phyla: there are a broad-headed phylum in which the horn appears very late, a precocious phylum in which the horn appears very early, a phylum in which the horn seems never to develop beyond a mere thickening of the nasal junction, and a long headed phylum in which the horn appears relatively early. Involved in these rectigradations is the idea of the potentiality of development of horns at different periods of geologic time, perhaps 100,000, 200,000 or 300,000 years apart. It is interesting to observe how from a face and cranium of equal size there evolves the elongated cranium of *Brontotherium*, the abbreviated face and the dolichocephalic condition. In time the horn becomes the dominating character of the organism and all parts are subsidiary to it.

A parallel study of the ontogeny of the horn in cattle, as worked out by Mr. S. H. Chubb of the American Museum, leads to the thought of the probability that all members of the family Bovidae had this general potentiality for developing horns; thus from the old concept that all horned animals are descended from animals with more or less developed horns we get the new concept that horned animals are descended from ancestors which had the potentiality for developing horns in a certain part of the cranium.

In the working out of the subject of allometrons, or changes of proportions, in the Titanotheres, most interesting results were demonstrated by living animals through modification by amputation of limbs, the influence of hormones, arrested growth of one or another bone, etc., as well as through the principle of natural selection.

The author of the Titanothere Monograph welcomes this opportunity to pay his tribute of appreciation to the large number of men and women who helped in the preparation of the great work, also to the liberality and large-mindedness of the United States Geological Survey in devoting no less than nine years to putting it on the press and, finally, to the genius of Roy Chapman Andrews, who in the Desert of Gobi fulfilled the prediction made in the early chapters of the work that the center of dispersal of the Titanotheres would be found, not in North America, but in central Asia. The author's parting word to Andrews was, "I hope you will find the Titanotheres;" Andrews' first message from Asia announced, remarkably, "I have found the Titanotheres" (the expedition's first fossil was an Upper Eocene *Protitanotherium*)! It is a coincidence that the first fossil mammal seen by the author as a youthful explorer at the age of nineteen was a Titanothere of the Bridger Beds of Wyoming.

THE LOUISIANA MUSKRAT

By Arthur Svihla and Ruth Dowell Svihla

[Plates 1–2]

This paper aims to record those data of scientific significance obtained while we were investigating the life history and habits of the Louisiana muskrat, *Ondatra rivalicia* Bangs,[1] during the years 1925–1927. The work was performed under the general supervision of the Louisiana Department of Conservation along lines suggested by the U. S. Biological Survey. A group of Louisiana men, interested in the muskrat industry and organized as the Louisiana Fur Industries, Incorporated, bore a portion of the expense for this investigation. Some of the more practical results of these studies have been given publicity from time to time by the Department of Conservation. The authors here wish to acknowledge their indebtedness to E. W. Nelson and Vernon Bailey of the Biological Survey, and to Julius P. Hebert of Morgan City, Louisiana, for many courtesies.

Apparently the first mention of muskrats in literature, according to Hollister, was made by Captain John Smith in 1612, when he described the commodities of Virginia.[2] From data compiled by H. B. Lotz, 1700 appears to be the earliest date of mention of the muskrat in Louisiana.[4] In the account by Father Gravier of the Society of Jesus of his

voyage in 1700 from the country of the Illinois to the mouth of the Mississippi, in describing the Tounika (Tounica) Indians of Louisiana, he states: "Most of the men wear their hair long, and their only covering is a scanty deerskin. They, as well as the women, sometimes wear cloaks made of turkey feathers or of muskrat skin, well woven and well worked." Later, in the same volume, speaking of the Houma Indians, located near the mouth of the Mississippi, Gravier says, "When they go out of their cabins, they wear a robe of muskrat skins, or of turkey feathers."

The Louisiana muskrat is a distinct species and differs from the northern species, *Ondatra zibethica zibethica*, both in characteristics and habits. In giving this muskrat the name *rivalicia*, Bangs states (in a letter) that he had in mind the meaning "of or relating to those who make use of the same brook."

The gulf coast region of Louisiana, in which this muskrat is found, is a vast extent of marsh lands, practically all of which lie within tidal limits. Intersected by numerous bayous and dotted with tree islands of various sizes, these marshes form a very prairie-like landscape. It is in the marshes proper and away from the bayous that the muskrats live.

For the observation and study of these muskrats in captivity, various types of pens and cages were constructed. These ranged from wire cages 3 by 4 feet to fenced plots 100 by 48 feet. The small cages were kept in the house so that the nocturnal activities of the muskrats could be closely observed. These animals, however, require range, and when confined in small cages become restless and dissatisfied and spend most of their time trying to escape. Wire cages 4 by 6 feet, or better, 4 by 8 feet, have been found to house successfully a pair of muskrats, and in these they remain fairly contented if given plenty of water and green food.

A type of cage advocated by some northern fur farms was tried out. These cages were four by eight feet and made with board floors and sheets of galvanized iron two feet high as sides. They were found to be very impractical for this climate. The sun pouring down upon the galvanized iron caused terrific heat inside and when the cages were shaded with narrow boards, circulation of air was impossible. Two muskrats died on account of the heat while others showed signs of distress. Then too, the muskrats, unable to see out, persisted in trying to escape by jumping over the top or gnawing through the board floor. Some succeeded in gnawing through the inch-thick floors. The floors were then

covered with hardware cloth but the pens still proved so unsatisfactory that they were discarded. It is interesting to note that as soon as the muskrats were transferred to cages with open wire sides and unprotected floors, they did not attempt to gnaw, for, being able to see out, they were more content.

A very convenient observation pen was built close to the house so that the muskrats could be watched at night. This was made of galvanized wire two feet high with a foot overhang. Corrugated sheet-iron roofing was sunk three feet into the ground and the wire was fastened to this at the surface of the ground. A foot of soil was removed and muck from the marsh was substituted. Marsh plants were planted in the plot from time to time so that natural conditions were simulated. Here, the muskrats dug runways and built a house just as they were accustomed to do in their natural habitat.

Except for purposes of close study, small cages are very impractical. They are not only expensive but entirely too confining. Even pens 100 feet by 48 feet are none too large for a pair of muskrats, unless they are fed with outside material. A pen 25 feet by 30 feet, supporting a thick growth of grasses and sedges, was denuded of vegetation by a pair of muskrats in one month. Another pen of the same size was then built alongside and although the greater range thus provided resulted in more diverse feeding places, yet in two months serious inroads had been made upon the vegetation.

The fact that muskrats are most fond of the underground shoots and white basal portions of the marsh grasses and sedges necessitates the use of a very large natural area, for it may safely be said that a muskrat wastes as much vegetable food as it consumes. For the close study of muskrats, cages and pens are necessary, but for fur-ranching on a profitable basis, no method of caging muskrats has yet been devised which is entirely satisfactory.

The Louisiana muskrat, because of, maybe, constant persecution, has an intelligence and cunning which seemingly far exceeds that of his northern brother. He has developed a certain caution regarding traps which proves his salvation.

During cold, still nights, muskrats work industriously, building their houses, digging runways, and searching for palatable bits of food. A very windy night or warm weather results in little activity. During the summer months, when the weather is hot and dry, signs of activity in the marsh, and also in pens where muskrats are confined, are exceedingly scarce. Plenty of water and cool weather are the most favorable

factors for muskrat activity. They are quite adaptable, however. Extremely high tides, and a temporary superabundance of water over the marsh, do not trouble them, and in the summer, when the marsh is dry and the days hot, they often plug up the surface holes of their runways, thus retaining the coolness and moisture within.

In all the southern marsh districts, these muskrats live entirely in the marsh proper. There they build their houses and runways and raise their families of young. They are never found in the bayou banks. In some rice-growing regions, especially near Crowley, they tunnel into the banks of the rice canals and even their nests and young have been found there. Thus, they cause much trouble and damage as they have to be eradicated each spring. Several years ago, when muskrats were very abundant and practically of no value, the damage done to the rice canals was very great. In those days, they also damaged the levees in some places.

The muskrat is a social animal in the sense that it likes company of its own kind. In several places in the marsh, we built pens of wire netting wherein pairs of muskrats were placed. By setting live traps beside these pens, we caught a surprising number of wild muskrats, considering the scarcity of signs in the adjoining marsh. In one pen, a pair of muskrats was placed. After several days to our great surprise, not only the original pair was found, but three additional adult muskrats. They had evidently climbed in over the two-foot wire fence which had a foot overhang, and having gotten in were unable to get out.

We have had three-legged muskrats escape from a wire pen two feet high with a six-inch band of galvanized iron along the top. Muskrats have also escaped from pens two and a half feet high with a foot overhang. They will often jump when it is impossible to climb. They have been observed to balance on the edge of their water pans on their hind legs, and when stretching was of no avail, to jump up onto the overhang and scramble over.

That water is the muskrat's natural element is evidenced by the speed and grace with which it swims, not only on but also under the surface. Muskrats have often been observed swimming under water with only a slight ripple on the surface indicating the progress of the animal. When frightened, a muskrat will immediately plunge into the nearest water with a startling splash. The ripples from the splash then serve to conceal any slight signs made of the under-water course. It is often impossible to tell where, and even in what direction, the musk-

rat has gone. In swimming, muskrats have been observed to move both hind legs alternately. Johnson, describing the swimming of two muskrats, states that he was unable to tell positively whether they used their hind feet simultaneously or alternately, "but judged by the action of the body that the strokes were made simultaneously."[5]

On land the muskrats' usual method of traveling is by a slow, lumbering walk. Their tails swing from side to side and assist in maintaining their balance. When frightened, however, they are capable of making strong lunges that carry them along at a faster speed. In trails made over muddy areas the mark made by the swinging tail appears as a sinuous depression midway between the tracks of the feet. When swimming, the tip of the tail is usually elevated slightly above the surface of the water and has the same undulating motion as when the muskrat walks on land. This movement has undoubtedly given rise to the impression that the muskrat is swimming by sculling with its tail whereas the tail is merely balancing the animal, the partially webbed feet actually doing the propelling. When sitting up or feeding, the tail is so placed as to prop the animal in position.

When caught or cornered, muskrats fight desperately, jumping and striking at their opponents, regardless of size. The incisor teeth are long and extremely sharp and are capable of inflicting considerable damage. Only during the breeding season have we found them fighting among themselves. In one case when two males were placed in a pen with only one female, a fight between the two males followed. The defending male put up no fight at all. His escape was impossible, and when the fight was interrupted and the injured one rescued, the skin on his back had been so torn that a wound three inches in diameter resulted. Upon another occasion, a small male was killed by a larger one. Other than these few cases, we have witnessed no fighting among muskrats even when as many as seven males and females were kept in one small pen.

Muskrats have several different vocal sounds. The young muskrats squeak in no uncertain tones when cold, hungry or otherwise uncomfortable. The sound is similar to mouse squeaks but can be increased considerably in volume. The adults often quarrel over their food when they are kept in close quarters, and then the sound is a high-pitched complaining "n-n-n-n-n." During the breeding season, when sexually excited, both males and females emit the same sound as above but faster and more emphatic. Sometimes, when badly injured in a trap, muskrats will give a low moaning sound, but usually they endure pain in

silence. Besides these purely vocal sounds, the animals, when nonplussed, frightened or excited, make a chattering noise with their incisor teeth. This is heard most often when they are captured or cornered.

A possible gesture of affection is the habit muskrats have of chewing each others' backs and necks. This has been observed most frequently during the breeding season, and is done both by the males and females. Never have these muskrats been observed to indulge in any sort of game or play. They work most industriously and spend a great deal of their time washing and combing themselves, but refuse to run wheels or to invent any play of that kind.

From observations of muskrats in the field and in captivity, it appears that their sense of hearing and smelling far exceeds that of sight. Although they are active chiefly during the night, yet in captivity they have little objection to artificial light and can be easily watched with a flashlight. We have found that they need hard foods, for when kept on a soft diet for any length of time their incisor teeth grow out too long. They are inquisitive animals for the most part and frequently test an unknown object by nibbling it. In fact, muskrats which escaped from pens in the house nibbled at almost everything, from Christmas cards to shotgun shells.

The marshes contain a great abundance of grasses and sedges, the seasonal growth of which is such that there is a plentiful and continuous supply of vegetable food for the muskrats the year round. These grasses and sedges occur more or less abundantly in different sections but everywhere sufficiently to form a conspicuous part of the vegetation. In fact, most of them grow in pure stands over considerable areas. The leaves, tender bases, young shoots, growing tips and underground runners of these are eaten. Although muskrats occasionally nibble and eat many other marsh plants which are not of such abundance or importance, the plants which compose their staple food supply include three-squares, (*Scirpus americanus, S. robustus*); needle grasses (*Juncus effusus, J. roemerianus, Fimbristylis castanea* var. *puberula*); paille-fin grasses (*Panicum hemitomum, P. virgatum, Spartina patens* var. *juncea*); roseaux or canes (*Spartina cynosuroides, Phragmites communis*); cattails (*Typha angustifolia* and *T. latifolia*); and saw grasses (*Cladium effusum*). The three-squares, needle grasses and paille-fin grasses are the most abundant and important foods.

The favorite foods eaten in captivity are, in order of their preference, rolled oats, corn, apple, fresh lettuce, wheat, rice and oats. Muskrats are prone to taste many things and will nibble upon a great many plants

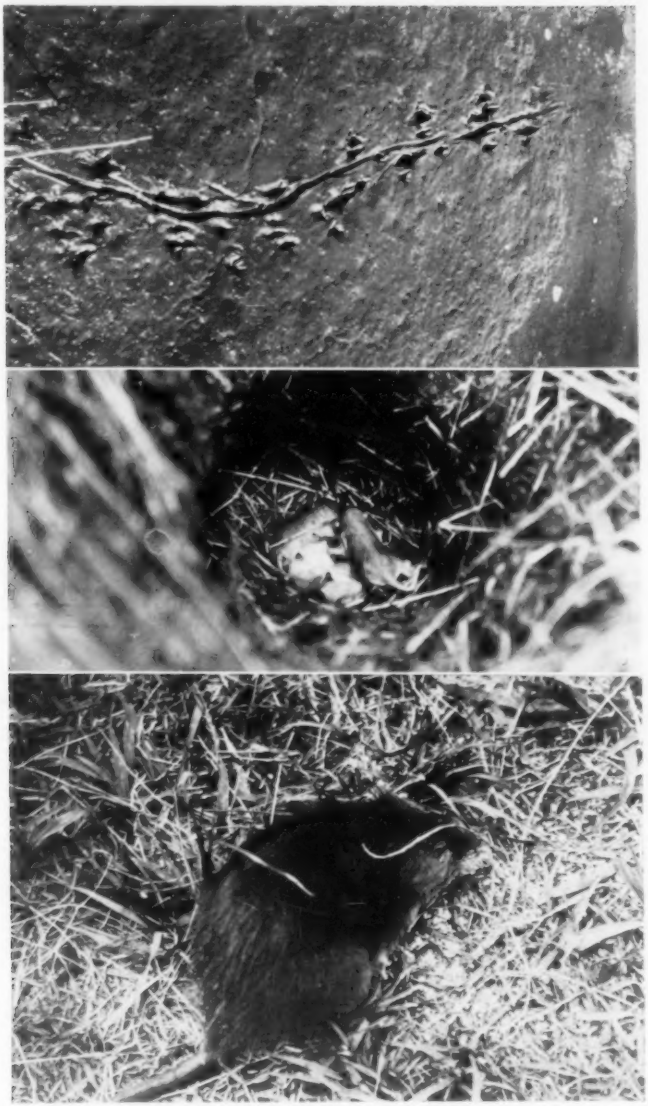
and foods that they will not eat as a steady diet. They are also quite individualistic in their tastes, for some refuse to eat carrots and apples, while others eat them eagerly. In captivity, we have found that they thrive very well upon a diet of corn and marsh plants such as paille-fin grass and three-square rushes.

Two experiments in feeding were carried on; one in which seven muskrats were fed green food only, while in the other, nine muskrats were given green food and corn. It was found that when the seven muskrats were fed paille-fin for twelve days, that each muskrat consumed, on an average, 10.19 ounces of green food a day. The average weight of these seven muskrats was 30 ounces, so that each muskrat consumed an average of 33.9 per cent of its live weight per day.

When nine muskrats were fed paille-fin and corn for fourteen days, each muskrat ate on the average 7.3 ounces of paille-fin, and 1.47 ounces of corn, per day. The average weight of these nine muskrats was 26.1 ounces, therefore each muskrat consumed an average of 20.3 per cent of its weight in paille-fin, and 5.6 per cent of its weight of corn, per day. This totalled 25.9 per cent of food. Thus, each muskrat in this experiment consumed approximately 8 per cent less of its weight in food each day than the muskrats in the first experiment mentioned. However, when green food only was fed, each muskrat ate on an average 10.19 ounces per day, whereas when fed green food plus corn, each muskrat consumed only 8.77 ounces.

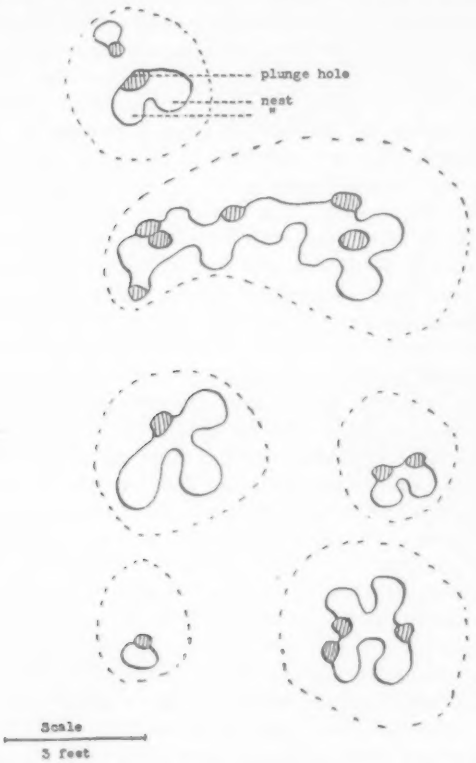
Muskrats, like a great many other rodents, occasionally eat animal matter. While live crabs cause consternation in their pens, yet we have seen them eat raw and boiled crabs as well as small dead fish. A few fish, about 3 to 4 inches long and commonly called "shad" or "sardines" by the natives, were placed in their pen and the muskrats, on several occasions, were observed to eat them. They took the fish in their front paws and ate the head first. The young rats ate these fish as readily as did the adults. Although the fish were alive when placed in their pen, by the time the muskrats came out to eat them they were dead.

It is a belief among trappers that muskrats habitually wash their foods before eating it. They do like to sit in the water while eating, and any muck clinging to their food naturally falls off. On one occasion a muskrat was observed to shake in the water a piece of particularly muddy root which it had in its mouth, but otherwise we never observed any intentional washing of food. We have often watched muskrats feed in the observation plots. Approaching the desired stalk of grass



LOUISIANA MUSKRAT (ONDATRA RIVALICIA). UPPER—TRACKS IN MUD. MIDDLE—YOUNG IN NEST. LOWER—ADULT

or sedge, the animal would rise up on its hind legs, reaching to the desired height to bite the stalk in two with its incisor teeth. Then, settling down upon its haunches, it ate the stalk, turning it in the paws meanwhile. In marshes where the water is constantly high, muskrats build



DIAGRAMS OF HILLS SHOWING NESTS AND PLUNGE HOLES

"feeding rafts" where they sit while eating. These rafts consist of platforms of debris, accumulated from numerous feedings and are really muskrat "kitchen middens."

The houses, hills, beds or nests, as they are called in various parts of the state, are used as nests for the young, as safe feeding places and

as sleeping quarters. Both male and female work to build the house. Usually an old feeding raft with its approach forms the first step in the construction of the new house. The approach develops into the plunge hole, and the feeding platform forms the basis for the inside of the house, which is then built up and around the plunge hole, making a small house with but a single nest. With the gathering of more material the house is increased in size and more nests and plunge holes are made as needed.

Johnson, in "The Muskrat in New York," states that the houses in that State are made up entirely of old, dry cattails of the previous season. Here, in Louisiana, the animals use green vegetation of the present season's growth. They also make use of the old houses, so much so, that most of the occupied houses are made over from the previous year and even the year before. The materials used are those closest at hand and include green vegetation interspersed with muck. One can tell that the house is occupied and that building is in progress by the bunches of fresh material dragged up onto it during the night. The building material is carried, dragged or pushed while the muskrat still holds it in its mouth. It is placed in a seemingly haphazard manner, yet a well-packed, matted roof results. This mixture of muck and vegetation, which is always wet except for the sun-baked outer layer, works like a thermos bottle. In the hottest weather, the inside maintains a cool, even temperature; while during the coldest weather the nest is kept constantly warm from the body heat of the muskrats.

The size of the houses varies; some are quite small, only a foot high and a foot in diameter at the base, while others may be as large as three to four feet high and eight to ten feet in diameter. Usually the small houses are made by a single muskrat, perhaps the male, while the larger ones are built by more than one muskrat, perhaps a pair. It has been our experience that a single male, placed in a pen, will build a small house with a single nest, but as soon as a female is placed with him, they both work until the house is greatly enlarged. As the size of house increases, so does the number of nests, and the size of these also varies greatly. Some nests are eight to ten inches in diameter and four to six inches high, while others are smaller. As many as five adult muskrats have been observed to pack two deep into a nest not more than eight inches wide. Nests in which the young were found always had an inner lining of soft, dry grasses that often covered the young. These nests were slightly saucer-shaped. They were always separate from the other nests and were the highest ones in the house, accessible usually to only one plunge hole. The dry material for this nest lining must have been carried in through the plunge hole and dried out afterward.

HOUSES OF THE LOUISIANA MUSKRAT. UPPER—IN PROCESS OF CONSTRUCTION. LOWER—HOUSE COMPLETED

The number of houses to a given area varies, for naturally some areas contain more muskrats than others. In many sections, even though the marsh vegetation is thick and water plentiful, no houses are found; while in other places there may be as many as six houses to an area twenty feet by fifty feet. The number of houses is usually the means employed by trappers to estimate the number of muskrats on a given area. It is assumed by trappers that houses with many nests contain many muskrats. Houses have been found with as many as 7 nests with plunge holes easily accessible. It may be that when breeding is in progress, but one pair of muskrats occupy a house. During other seasons, especially during the winter months, the inhabitants apparently vary in number, for from one to four muskrats have been trapped at one house.

In digging canals and runways, the muskrat digs with its front feet, casting the material up between its hind legs. Then taking a step forward, it pushes the material farther out with its hind feet. This is done on the surface as well as underground.

Marshes which harbor muskrats are netted with runways, both on the surface under the thick cover and underground. When one is walking through a muskrat marsh, one is constantly sinking into these runways which often form veritable labyrinths. Where houses are not very far apart, the surface runways connect one house with the other. The underground runways are often quite deep, measuring in some cases as much as three feet. During hot, dry summers the openings to these runways are often plugged with muck.

Muskrats, like many other rodents, are very clean. They spend a great deal of their time washing and combing their fur. While working on their houses or digging runways, they stop every little while to wash and comb. Upon emerging from the water, a slight shake is sufficient to flick the muddy water from their fur. Excrement is almost always deposited in the water and none is ever found in their nests or houses, which are always sweet and clean. Sometimes a small accumulation of pellets is found upon a resting platform or feeding raft. When muskrats are kept in small pens, a pan of water, changed daily, is entirely sufficient to keep the pens sanitary.

Muskrats are most careful in keeping any wound clean by constant licking. If the flesh becomes infected, they do not hesitate to gnaw it away. In many cases—evidenced by three-legged, two-legged, and even one-legged muskrats being caught in the marsh—they have been able to heal legs amputated by traps. In some cases, this simple licking

method is not sufficient to preclude infection and we have found that frequent antiseptic baths are most successful in counteracting septic poisoning and complications. In most cases, it is sufficient, after a leg has been amputated, to place the muskrat in a cage by itself and by placing a little Dakin's solution in the waterpan each day, the wound is helped to heal quickly. Pus sacks occasionally form on muskrats whose legs have been previously removed. When these pus sacks are removed, the muskrats make strenuous efforts to lick up the pus.

When muskrats and other animals caught in traps have broken legs, immediate amputation becomes necessary. The following method was used throughout this work successfully: the muskrat is placed in a small box (a rolled-oats box proved very efficient) by seizing it by the tail and lowering its head first very quickly into the box. The box is covered quickly before the muskrat has time to turn around and climb out. A small wad of cotton is saturated with ether and placed in the box which is kept covered tightly. Muskrats 'go under' quite readily and usually a few minutes is sufficient. A very good indication of sufficient ether, is the fact that the muskrat is quiet but still blinks its eyes. It is then placed upon the operating table and a cornucopia, made of paper in which is a wad of cotton saturated with ether, is placed over its nose. Care must be taken that too much ether is not given. One person watches and regulates the amount of ether, while the other does the amputating Dakin's solution (about 5%) has been used most successfully both for sterilizing the instruments used and for washing the wounds. With scissors, first cut the leg off where the bone is broken. Then with a very fine saw, saw the bone as far as possible above where the flesh is cut, in order that the muscles can grow over. A clean cut is necessary as sharp points on the bone cause pus to accumulate later. The wound is then washed with Dakin's solution. With a needle and thread pull the skin together over the end of the bone. All this should be done very quickly with the loss of as little blood as possible. The ether cup is removed and the muskrat placed in a box on clean grass or excelsior. A small pan of water into which a little Dakin's solution has been placed is put in the box which is then covered so as to be semi-dark but also provide a circulation of air. In a few hours, if the operation has been successful, the muskrat is recovered and ready to feed. It may be fed corn, apple and green food until the leg has healed. The pan of water should always contain a small amount of antiseptic in order to aid in the healing.

Although we have found young muskrats or embryos every month of the year, yet the heaviest breeding appears to take place from November to April inclusive. During the trapping season of 1925–26, 600 adult muskrat carcasses were examined. Of those examined from December 8 to December 31, 251 were females, 213 were males and 64 were kits or young. Of the 251 females, 26 or 10 per cent contained embryos. Of the carcasses examined during January, 1926, 137 were females, 123 males, and 60, kits. Fifteen, or 11 per cent, of the 137 females were pregnant. Of the entire 600 carcasses examined 325, or 53 per cent, were females of which 41, or 14 per cent, contained embryos. Of the 124 kits examined, 65 were females and 59 males. It is to be noted that the percentage of both kits and females with embryos increased considerably in January. During the middle of that month, fur-buyers said that they were receiving approximately 25 per cent kits. These were, no doubt, born the previous fall.

During the 1926–27 season, 263 carcasses were examined. The trapper from whom we obtained the bodies made a very small catch during this season, due to the unusually warm weather in December and the great amount of water over the marsh in January. By the beginning of January, he was catching so few muskrats that he ceased trapping for the season. Of 153 adult carcasses examined in November, 99 were males and 54 were females. Of the females 14, or 26 per cent, contained embryos. Of 110 carcasses examined in December, 75 were males and 28 females. Seven, or 25 per cent, of these had embryos. Thus, out of 263 carcasses for the season, 89, or 33 per cent, were females, of which 21, or 23 per cent, contained embryos.

The size of the embryos found in the above mentioned carcasses varied from the size of a pea to some $2\frac{1}{4}$ by $1\frac{1}{2}$ inches, these last evidently about to be born. The number to each carcass varied from one to six, with an average of 3.7. The following frequency table, based upon 66 carcasses, illustrates this;

Number of embryos	*Number of pregnant females*
1	3
2	4
3	20
4	29
5	8
6	2

The following is a similar table based upon litters of young found in the field;

Number in litter	*Number of litters*
1	4
2	5
3	4
4	1
5	3

Here, one, two and three occurs with the greatest frequency, indicating a possible heavy mortality among the very young muskrats.

After the trapping season closes in February there is generally high water in the marshes until the end of April. During these spring months, the muskrats, now undisturbed by trapping, are very active. This is evidenced by vigorous digging and house building and by the fact that young muskrats may be found in many of these houses during the spring months.

Most of the literature concerning muskrats states that the young are born "naked, blind and helpless." Very young muskrats, weighing only 21 grams, have been found in nests, blind but hairy. Large embryos have been taken that had a sparse covering of hair which is distinctly visible. Thus, it is evident that the Louisiana muskrat is born with hair. The mammae can be be seen before the eyes are open, and before the hair on the bellies of the young females has grown to any considerable length. They range in number from eight to ten, with eight as the more usual number.[6]

Amputated legs do not hinder muskrats from breeding. One male has been observed to mate with three different females upon different occasions during the same breeding season. This indicates that the males are polygamous, though Seton inferred that they are monogamous.[7] The females also accept the attentions of various males. It is interesting to note that upon every occasion when mating was observed, the muskrats were partially submerged in water. Before mating, the males and females were observed to back up against the sides of pens elevating the hind portions of their bodies and leaving an intense odor of musk. We have often noticed these musk places in the marsh, especially during the winter and spring. That mating depends upon the female and not upon the male is very evident. If the female does not wish to mate no amount of coaxing upon the part of the male has any effect. In fact, the female fights him off. But as soon as the female is willing to mate, she squeaks and leads him to the water pan where mating occurs. Sev-

eral matings occur upon each occasion, after which thorough washing takes place. Both male and female indulge in a veritable conversation of squeaks at this time. Although several unmistakable matings were observed to take place, no young were produced from these.

In order to determine the approximate rate of growth of young muskrats, weights of three kits kept in captivity were taken at intervals. On the last of April, a kit, No. 1, was taken from a hill in the marsh. It weighed 2¼ ounces and was quite able to feed upon grasses and grain and take care of itself. Two other larger muskrats were taken during the first week of May. They both weighed 4 ounces; one was a male (No. 2) and the other a female (No. 3). As they were found in the same nest they were undoubtedly from the same litter. Weights of these three young muskrats were taken every week for seven weeks in order to obtain relative rates of growth. It was found that No. 1 gained 9¼ ounces in 47 days, or quadrupled its weight in 7 weeks. Muskrat No. 2 gained 9½ ounces in the same period, and more than trebled its weight in 7 weeks. The third muskrat gained eight ounces in 47 days, or just trebled its weight during this time. When a muskrat weighs a pound, it may be considered to have reached the size of an adult. Hence, six months is ample time for a muskrat to develop from birth to adult. Muskrats born in the spring would be of trappable size by fall.

As an illustration of the growth of muskrats under natural conditions, the following notes were recorded. On March 29, 1926, a house in the marsh was found in which were two young 'mice,' as the young are called. A live trap was placed in the nest using the young as bait, in the expectation that the returning parent would be caught. Next day, the trap was found sprung but empty with the nest material plugged in all about it. At one side of the house a new nest had been built and in it were the two 'mice.' The trap was re-set as before and the next day the same trick was played. After it was noted that the young were about three inches long, had their eyes unopened, and were evidently still nursing, the trap was removed. On April 11, this house was again visited. This time a four foot water moccasin (*Agkistrodon piscivorus*) was found at the base of the house in the act of swallowing a half-grown kit. The snake was killed and another kit of the same size was found in its stomach. These kits were about twelve inches long, had their eyes open and were able to feed on marsh grasses as bits of grass still remained in the mouth of one. Although the nest in the house still felt warm to the touch, it was empty. Hence, we assumed that these

two kits were the same ones which we had found there on March 29. If so, they had practically trebled their length in two weeks.

Muskrats are not the only animals which occupy muskrat houses. The damp, warm house material harbors ants and other insects, skinks, frogs, toads and snakes. The snakes include the small garter snake, *Thamnophis proximus*, and the southern king snake, *Ophibolus getulus holbrookii*, which have been found during cold weather under the top layers of materials. Moccasin snakes, *Agkistrodon piscivorus*, and blue runners, *Coluber constrictor*, have been seen basking on top of the muskrat houses. Skinks, *Leiolopisma laterale*, (identified by G. K. Noble of the American Museum), are frequently found between the layers of the materials and even lay their eggs there; the damp, warm surroundings no doubt proving a help to incubation. Frogs and toads, especially the narrow-mouth toad, *Gastrophryne texensis*, and the toad, *Bufo valliceps*, bury themselves in the house material during cold snaps. Ants and beetles are always numerous, especially the former and although, when disturbed by opening the house, these ants have been seen to swarm over very young muskrats in their nests, yet they evidently do not bite them. However the bites from these enraged insects often prove excruciating to the disturber of the muskrat house.

Injudicious trapping is the greatest enemy of the muskrat, but its numbers are kept down by several animals that include it in their diet. The fact that the muskrat is very wary and either stays under cover or else very near it, is a great help in its eluding animals of prey. Analysis of several alligator (*Alligator mississipiensis*) stomachs showed that these reptiles feed upon muskrats. However, alligators have been hunted so extensively during the past few years that they are rapidly becoming scarcer. Moccasin snakes, as noted above, have been observed to eat muskrats. One pellet of the barred owl (*Strix varia alleni*) was found to contain remains of a muskrat kit. No direct evidence of hawks killing muskrats has been found, although trappers insist that they tear the pelts of many muskrats caught in traps. Minks have been reported as killing muskrats but we have been unable to collect any direct evidence of this.

Like the northern muskrat, this species is also infested by a mite, which has been identified by H. E. Ewing of the U. S. Bureau of Entomology as *Tetragonyssus spiniger*. Practically all of the muskrats examined, even young in the nests, were infested with them. These mites seemed to attack chiefly the eyelids of the muskrats.

Surprisingly few endo-parasites have been found. Out of ten muskrat

carcasses sent to H. B. Ward of the University of Illinois, none contained endo-parasites. One muskrat specimen sent to H. W. Manter of the University of Nebraska contained a degenerate arachnid. No diseases have as yet been found.

Of all the climatic conditions which are detrimental to muskrats, drought and floods seem to be the worst. Drought not only decreases the amount of available water in the marsh, but also affects the vegetation, thus decreasing the amount of muskrat food. Floods which cause high water to stand over the marsh for a great length of time, rot the vegetation and hence also destroy muskrat food. Marsh fires, set during dry weather when there is very little water on the marsh, are very detrimental. These not only burn the vegetation, destroying food and cover, but also destroy many houses and even the muskrats themselves. Judicious firing when there is plenty of water on the marsh has been witnessed, and no damage was done, for the high water prevented the roots of the plants from being burned and the hills were too wet to be damaged.

After the hurricane of August 28, 1926, the water was very high over the marshes in the Penchant region for a short time. A survey proved that it had not damaged the muskrat land at all. The muskrats were very active building their houses higher.

Although the original range of this coastal muskrat included small areas in southwestern Alabama and Mississippi and across the marshes of southern Louisiana into southeastern Texas, yet Louisiana has practically all of the muskrats. The muskrat lands in Alabama and Mississippi, restricted to small areas in the first place, are now practically depleted, due to constant and injudicious trapping. Louisiana is in danger of repeating the history of her sister states. Statistics compiled in 1928 show that during the 1924–25 season, Louisiana produced over six million muskrat pelts, while Canada, for the same season, produced something over three million pelts of all kinds. The tremendous annual drops in the number of pelts taken in Louisiana since then, clearly show the inroads made upon this crop. During the 1925–26 season, according to the report of the Director of the Fur Division of the State Department of Conservation, only 3,285,241 pelts were harvested, while in 1926–27, these dropped to approximately 3,000,000. These conditions were brought about by the inter-depending factors of fur demand, resulting in high prices, and the consequent influx of trappers. The "big money" in trapping induced small town icemen, clerks and others to quit their jobs and rush to the marshes. In order to accommo-

date this increase in the number of trappers, the land agents, also eager to make as much money as possible, not only reduced the size of the trapping ground allotted to each trapper but also raised the price of the land. The following data show the somewhat conservative catch of one trapper and illustrate the decrease in the number of pelts taken and the increase in price of the individual pelt. This trapper had a quarter-mile front on Bayou Penchant and trapped back into the marsh for a mile where his land widened to about a mile.

SEASON	CATCH	PRICE PER PELT	PRICE OF KILTS	TOTAL VALUE
1922–23	500	$0.20–$0.30	$0.05–$0.10	$125
1923–24	2,000	0.15– 0.40	0.10	600
1924–25	1,300	0.75	0.15– 0.20	1,100
1925–26	650	1.75	0.35– 0.40	1,000
1926–27	650	2.25	0.30	800

This trapper was one of the minority in that he took a conservative catch from his grounds and did not hesitate to pick up his traps when low daily catches indicated that the muskrats were becoming scarce.

The general attitude among the majority of trappers is that there always have been muskrats and there always will be. If they are scarce one year, they are bound to "come back" the next. Statistics, however, show such decreases each year that the necessity of enforced conservation is evident. With the practice of strictly conservative and intelligent trapping there is no reason why the muskrat industry in Louisiana cannot be developed with reasonable profit and continued indefinitely in the future.

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THE RACCOON AND ITS HUNTING

By Leon F. Whitney

If we as a people wished to adopt a national animal, just as we have adopted the eagle for our national bird, what better one could we find than the raccoon? The raccoon is a native of every state in the United States. His pelt was at one time used in place of money. He ranks as among the most intelligent of mammals and has proved his ability to survive where many other animals have succumbed.

Yet despite this prevalence the raccoon is one of the least understood of the mammals, partly because he is a nocturnal animal, and most of the observations made upon him have been of the circumstantial-evidence variety. Then, too, altogether too many observers have been willing to accept the evidence that they have deduced from the observation of captive raccoons. At my home we usually have one or more pet raccoons, but the following observations were made chiefly from raccoons in the wild state. For many years now the author has been an ardent hunter. He has never trapped one in his life but has used dogs which he has trained himself to good effect, and it has been the combination of training dogs and observing their mental aptitudes together with the thrilling uncertainty of raccoon hunting that has given him a great deal of pleasure in the fall for a good many years past. Besides the hunting, he and several members of his family have spent many Saturday afternoons throughout the spring and summer making frequent excursions into the woods and observing the telltale tracks in the mud along brooks and around the edges of ponds.

In the past five years the author has taken 128 raccoons with dogs he has trained himself, and in the last season he obtained forty-five. It may be well to detail in some degree just how this raccoon hunting is carried on by the author which will indicate why he has had such an excellent chance to observe the animal in the wild state.

First of all, only dogs have been used which bay on the trail of the raccoon. Some hunters prefer still trailers but the author uses only trail-barking dogs. Two years ago the author's best dog which up until then had been one which barked on the trail, for certain reasons changed into what might be called a partial silent trailer. When he first found a raccoon track in the woods he would emit one sharp bark and then at intervals of fifty to one hundred yards he would bark as he followed the track. When he got to the place where the raccoon had actually started to run he would begin to bay with a different type of voice entirely,

following the trail until he got to the point where the animal climbed a tree or went into a ledge. Then he would stand at the foot of the tree or at the ledge and bark with another different tone. All of these tones of voice indicated different things to the author so that he knew at all times just what the dog was doing.

When using this particular hound or other hounds the party of hunters would go into the woods where they thought raccoons were likely to be living and would sit down and let the dog do the hunting. The dog would range out in large circles and sometimes would hunt simply by smelling the air drifts, and when he ascertained where a raccoon was then he would bark as described above. This method of sitting and listening to know what the dog is doing affords a splendid opportunity for observation.

The hunting season has usually been from the middle of October, sometimes extending until the first of February. The hunting party usually starts out soon after dark and arrives at the woods by 7.30 or 8.00 o'clock and sometimes hunts until daylight but usually returns home soon after midnight. The author has hunted in Arkansas and in all of the New England states, but most of his hunting has been confined to southern Massachusetts and all parts of Connecticut. Following are presented certain observations on the pelage, the weight, feeding habits, and of some of the raccoon's physical propensities.

PELAGE

Undoubtedly through climatic selection raccoons vary considerably. In the South the undercoat is much lighter than it is in the North and the general weight of the hide is considerably less. The body part of raccoon-skin coats are made almost entirely of southern raccoons and the trimming (collars and cuffs) is from the northern raccoon. In fact, a coonskin coat made from northern skins would be so heavy as to be almost unbearable and would be very uncomfortable.

There is little need for a southern raccoon to have a heavy coat, and it would be a disadvantage, naturally, for a northern raccoon to have a light coat, and so the adjustment of nature has been made to suit the raccoon to the climate.

We often hear of the so-called Samson fox, which is one that has lost its guard hairs. Apparently there has been no record of such a condition in the raccoon heretofore. Last fall when hunting in Maine the author treed a mother and two young ones not far from the town of Brunswick and all three were entirely lacking in guard hairs, only the undercoat

remaining. On another night near the same locality another old male was treed that also had lost its guard hairs.

Coat color is variable, ranging all the way from very light to a black. Apparently there are several pairs of genes working on the ultimate coat color of the raccoon. The author once took a raccoon in Massachusetts that was lacking all of the black pigment in the coat and only the yellow remained, but the bands were noticeable on the tail. On the other hand, he has taken one in the wild state in Vermont which was almost entirely black. There are now farms breeding raccoons which specialize only in the black ones. These are not all black individuals in the truest sense of the word but simply an extreme variation of the gray, and always show some gray around the head. The bulk of the body coat, however, is entirely black. From observations made by the author on these raccoon farms where black and gray have been mated, he concludes that the black tends to be recessive to the gray. Blacks mated to grays usually produce grays in the first generation providing the gray parent is pure for that character. One of the half-breeds mated to a black will give pups ranging in color from a gray to a black.

WEIGHT

The author has read accounts of raccoons which weighed as much as fifty-five pounds. Such racoons are weighed with the imagination and muscles of men rather than by mechanical scales. There are, however, some raccoons hunters who can be guided by scientific intentions rather than by guess. Eight years ago the author selected several such men and asked them to report the exact weight of the large raccoons which they caught. These were Massachusetts and Connecticut men. These men and the author have taken over three hundred raccoons during the past seven years. Every one which appeared to be uncommonly large was weighed on accurate scales. The largest of the three hundred weighed twenty-two pounds and ten ounces. Three hundred is a representative series, but the average weight cannot be given because only those raccoons which appeared to be extra large were weighed. It is the author's belief that the average would be close to thirteen pounds, this because a good many of the animals taken in the fall were those born the spring of the same year, and most of these were not able to attain a weight of much more than ten pounds. The three hundred were taken prior to the beginning of the 1929 season.

Dr. Robert J. Sprague, who was President of Rollins College in Florida, was an ardent observer of natural history. When he was

professor of sociology at the University of Maine at Orono he made certain observations of raccoons, which were never published. He suggested to the author that if he wanted to obtain some extra large ones that he should try his luck in Maine around Orono or south of it. Accordingly last fall the author and a friend tried a section in back of Brunswick and hunted for five nights. During these five nights eighteen raccoons were taken, eight of which weighed over twenty-three pounds. The largest weighed twenty-seven pounds including the sack in which he was held, which, in itself, weighed probably no more than a pound and nearer to three-quarters of a pound. Not only were the weights of these raccoons uniformly greater than those in Connecticut and Massachusetts, but the type of pelage was also very different. The hair was much shorter and the undercoat was decidedly thicker. In fact, there was such a decided difference that one might almost say that the raccoons in that section of Maine constitute a different sub-species. They were just as different from the Connecticut raccoons as the Connecticut animals were different from those from Arkansas.

The author has not been content with weights alone, for quite often one finds raccoons in the late fall which are big and long and yet have very little fat, showing that they would weigh considerably more if they had plenty of the right kind of food. Old hunters report that the raccoons formerly taken in southern Massachusetts and Connecticut seemed to be much fatter than they are today. This is very likely due to the fact that there were plenty of chestnuts twenty years ago whereas they are absent today, and this probably accounts for the fact that we so often take raccoons with large frames but with very little fat upon them.

Of the three hundred raccoons previously mentioned the largest one was forty-eight inches from tip to tip; that is, the skin being held by the nose with the tail touching the ground measured without stretching, forty-eight inches. The raccoon mentioned above that weighed twenty-seven pounds including the sack, measured fifty-three inches from tip to tip, so it was not only heavier but a larger individual as well. Several of the others taken in Maine measured in the neighborhood of fifty inches.

Several years ago a friend of the author, Mr. J. A. Graydon, who owned a raccoon ranch, was interested in testing the weights of raccoons and inserted an advertisement in one of the most widely read sporting magazines saying that he would pay $1 a pound for any raccoon which was sent to him which weighed more than twenty-five pounds. This

advertisement was inserted at a time when the average raccoon was selling for about $5, so it offered a decided incentive for anyone to send a large raccoon and obtain a good price for it. During the several months that this advertisement was allowed to run only two raccoons were sent. One from Florida weighed thirty-one pounds; the other came from the West and weighed twenty-six pounds.

From all the information available the author believes that throughout the United States the average weight of a well fed mature raccoon ready to go into his period of lethargy is about twenty pounds.

FEEDING HABITS

Probably the most important observation that the author can add to the literature of the raccoon has to do with his feeding habits. For many years now the author has opened every raccoon caught and observed the characteristics of the food eaten. This was done not only from an investigative point of view but also because a knowledge of what food raccoons are eating at certain times of the year helps the hunter greatly in deciding in what locality to hunt. The range of food has not been as wide as one might expect, and contrary to popular opinion there has been very little meat in the stomachs of raccoons that were opened. The following items have been found: Corn, Oats, Nuts, Wild cherries, Apples, Pears, Grapes, Crickets, White grubs, Trout. It must be remembered that this list represents only the food found in the stomachs of raccoons taken between October 15 and February 1, and the above items are the only items that have been found in the stomachs of wild raccoons with a few exceptions. These exceptions are several raccoons taken close to civilization. Two were taken near a large summer camp which was unoccupied except for two or three people who had stayed late in the season. The raccoons had obviously been feeding from the garbage pails of these camps, and we found one of the pails had been tipped over and the contents pawed over. It was noticeable that in the fall the contents of the stomachs have been largely of a carbohydrate and fat nature, and actually very little protein has been found. Raccoons at this season seem to be intent on gorging themselves with corn, nuts, grain and fruit. Possibly in other sections of the country than those represented the diet of the raccoon is very different.

The author realizes from his experiences with pet raccoons and others in captivity that the animal will eat almost anything but from observation of raccoons in the wild he concludes that the diet in spring is highly protein in nature. The raccoon eats a great many frogs as well as

fish, and no doubt many crawfish are taken from the brooks, and along the beaches large quantities of shell fish are consumed. The spring is the time when the raccoon does not need large amounts of carbohydrates because there is no necessity for storing up fat, but as cold weather approaches and as the season advances the raccoon gorges himself with carbohydrates for fat. Fruits contain large amounts of sugar and are fattening, and nuts are well known for their fat producing qualities.

In the section of Connecticut close to New Haven where the majority of the raccoons taken last fall were found by the author every raccoon's stomach was at least half full of beechnuts. When one examines the meal which the raccoon has taken the smell is not in the least obnoxious. In fact, the contents of the stomach usually have a rather pleasant odor. The nuts are very finely ground and pulverized, and usually the beechnut meal found in the stomach is very white in color.

Sometimes in the fall a raccoon will be started from an old rotten log that it has been pawing through to find the white grubs which it contains, and from such a place one usually finds quite a number of white grubs in the raccoon's stomach. Curiously enough these are not chewed nearly so well as are the nuts.

So we conclude that the diet of the raccoon corresponds quite closely to his seasonal needs. Food is fairly abundant in most sections, and the raccoon has a wide choice, but the food that he does consume is that best fitted to the purposes of the season, according to our general knowledge of dietetics.

The author would like to draw the attention of dietitians to the following facts. It is claimed that vitamines are not stored in the animal system and that animals need continual supplies of them to be healthy, but if such is the case how do they account for the fact that the raccoon goes into semi-hibernation and stays there for the greater part of the winter, coming out only on warm nights and having very little, if anything, to eat throughout the whole winter. Even raccoons in captivity do not have large appetites during the cold weather and sometimes for weeks at a stretch will eat nothing. In the north there is sometimes a month or six weeks during which the raccoon will be in a semi-hibernation state from which it will emerge, and following this it will likely go into another semi-hibernation period that may last most of the winter, during the period of gestation.

It would seem that the raccoon absolutely contradicts the claim of the dietitians that vitamines cannot be stored in the body. Even after the long period of lethargy the raccoon comes forth in the spring fully energized and able to take care of himself.

Unquestionably the most common error into which writers have fallen in regard to the habits of raccoons is that the raccoon washes most of the food that he eats. *Lotor* means the washer, but in the wild state the raccoon washes almost nothing that he eats. It would appear to the author that the name of the raccoon was given to him after observations had been made upon raccoons in capitivity and not in their natural state.

Take for example the foods enumerated above as having been found in the stomachs of raccoons which were captured. A very small amount of these foods grow in or near brooks. Only the trout actually live in the water. Sometimes the author's dogs have surprised raccoons which have been eating trout, and the author has found part of the remains of the trout along the brook. Possibly the raccoon has washed this trout but quite often the author has found the remains two or three feet away from the water of the brook. He does not wash the corn that he eats; he does not wash the nuts or the fruit that he eats. In fact, what is there that he does wash?

In the spring the author has seen a raccoon catch a frog in the swamp in the late afternoon of a drizzly day. The raccoon pawed the frog over in the water and ate it just as a man might eat a piece of bread and butter, and in that case there was very little attempt to wash the frog.

The author has never seen any evidence that any raccoon has dragged food to a pond or to a brook to wash it. This statement was once made to a farmer who contradicted the author and showed him ears of corn that had been taken from a cornfield into the woods and toward a brook. After careful study it was found that squirrels had been dragging the ears of corn away and not raccoons dragging them to the water to wash them, and in fact when the water was inspected no evidences of corn were found near the edge. The author is wont to believe that practically none of the food which the raccoon eats is washed despite the fact that so many of our natural historians have assured us that it is.

PHYSICAL QUALITIES

The author would like to pay his respects to the physical prowess of the raccoon, an animal which has so many defenses and has such tremendous strength for its size. It is not a swift but it is a dextrous runner, and in general when pursued it uses good judgment where it has had any experience in the past. Incident after incident might be related where the author has been led to a thorough appreciation of the

powers of this animal. Only the inexperienced ones do foolish things. There are some raccoons which probable never will be taken by dogs, even by the still-trailing dogs that sneak up and surprise them. The inexperienced raccoons are so curious that when they hear a dog or man in the woods they will run a few feet and go up a tree and sit there and observe what is going on. They show very little fear in the tree. The author has treed whole families of them. On one occasion in the fall of 1929, a mother and three large young ones were treed in the same tree. The author climbed the tree, which was a very high one, and sat there with a powerful searchlight playing on the family of raccoons and observed them for a long time. Only the mother showed any sense of responsibility and she showed a very great deal. The young ones, however, sat there lapping each other around the ears and apparently enjoying a family party. The scene was so touching that all but one were left in the tree and he was shaken out and brought home alive. In this paper there is no attempt to discuss the psychology of the animal, but a discussion of the psychology of raccoons in the wild state would make a long paper in itself.

Sometimes raccoons will have been caught in traps and have some or all of the toes on their front feet cut off. Most of these animals cannot climb a tree, but it is such raccoons as these that make one respect the physical prowess of the species. Last fall the author's dogs chased one of these animals for four hours, and the dogs were exceedingly fast hunters. On another occasion one of these fast dogs chased one for seven hours, and the raccoon played trick after trick on the dogs, went into inaccessible places, climbed up trees over brooks and ponds and jumped off into the water where the trees were leaning ones and the raccoon could walk up them without having the use of the claws of his front feet. One night a farmer's boy caught this raccoon in a trap. It was found that only a stump of one front leg remained, and all but one or two of the claws were missing from the other front foot. In several places known to the author there are raccoons that cannot be caught by a dog, but in these localities there is every assurance that there will be a good chase any time the dogs are turned loose. Probably these are raccoons with missing toes.

And then there are raccoons which have never been damaged in any way but can fool the dogs for hours at a time, and finally will run into a deep rock ledge and be perfectly safe.

Several of the works on the raccoon state that the family of raccoons lives in a small area and does not go very far from home. This is true only during the early part of the season, but in the fall they may wander

a considerable distance. On a number of occasions the author has followed a family of raccoons for four or five miles, and quite frequently an old male will go for many miles climbing up tree after tree and investigating as he goes. On one occasion in Hampshire County, Massachusetts, the night before the first hard snow storm the author's dog followed a track for over six miles which went almost in a straight line and the raccoons were found denned in a large, hollow tree. Six raccoons were taken out of the tree.

Families of raccoons make fairly long journeys when hunting for food. Where food is not plentiful they will leave for another area and live in the trees beside a corn field, for example, eat at night, drink at a nearby waterhole or brook, and go back to sleep in the tree, sometimes for several weeks at a time. Where families of raccoons travel together almost the entire responsibility is assumed by the mother, and the young raccoons follow her blindly. Just when they begin to take a sense of responsibility is not known, but apparently not until after the first year. On a number of occasions the author has known his dog to be pursuing a family of raccoons. The dog has come to a tree and bayed, then after baying for some time has circled the tree and picked up a track and gone off on it. In such cases as this the author has stationed one or more men at the tree and told them to stay there while some of the other men in the party have followed the dogs. In almost all of these cases it is found that the dog is following the old female raccoon, and she may play trick after trick on him and usually get away into a rock ledge. On returning to the tree generally the rest of the family is to be found in it.

This brings to mind observations about the mating season. The normal mating season of the raccoon in the New England states is the last week in January. This fact alone should convince the game and fish commission of any state that no raccoon should be hunted in January. During the early part of January when they are not in hibernation raccoons will be looking for mates. The Connecticut legislature, when apprised of this fact, three years ago, immediately changed the open season of the raccoon, ending it December 31. Every state legislature in the Union, when it knows that the mating cycle of the raccoon occurs in January, ought to take a firm stand to protect the animals during that time which is one of the most effective times for protecting all wild life.

The gestation period is in the neighborhood of nine weeks. The young remain in the den quite a number of weeks before they come out for the first time and climb down the tree or out of the rock ledge to inspect the neighborhood with their mother.

Sometimes the female will skip the winter mating cycle due perhaps to lack of a mate or for some other reason, and in that event generally the mating will take place in the spring, and the young will be born in August. The author has treed a large number of similar small-sized young ones. Usually these were in the fall. Usually these will not weigh much over three pounds and sometimes under that. One wonders whether they will survive through the winter under natural conditions because they have such a short time to put on fat, and it is not fat that they need for their growing period but rather protein.

It will be interesting to many to know that when a raccoon has gone into his den the dog is not able to smell him, even though he is an experienced raccoon dog and trained to detect such scents. The author has gone to dens in which he knew the raccoons lived in the fall and has found them curled up and sound asleep, and yet the dog on the ground, in one case only six feet away, could not tell that there was any animal in the tree. He has seen this thing happen repeatedly both in trees and in rock ledges. Apparently the raccoon has to make a track on the ground or a recent track up the tree for a dog to be able to detect it. Very likely the ingredient which the dog can smell and which is furnished by the raccoon to the atmosphere results from exercise.

Lastly, it would seem worthy of notice that the time of the raccoons' inactivity is determined by the temperature and the food supply is largely a relative matter. In the early part of the fall when the average night temperature is only relatively high as compared to the average for the whole winter, raccoons will be found out in the evening. Let a night come which is colder than the rest of the nights previous, and no raccoons will be found out of their dens. Now, suppose that on this night the temperature is thirty degrees, the raccoons will be in during that night, and if the next night is a warm night they will come out and stay out nights until the next cold night occurs, and by cold I mean cold in comparison to the nights in the immediate period.

In December the raccoons will be found out on nights which may be as cold as twenty degrees, and when the temperature drops to twelve or fifteen the raccoons will not be out. But temperatures which will make them go into their dens and stay there in the early part of the fall will not trouble them at all in the later part of the fall. It seems to be an entirely relative matter, and the same condition applies throughout the winter. The warm nights all during the winter will bring the raccoons out, and the cold nights will keep them at home.

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THE CRANIAL CHARACTERS OF THE HAWAIIAN DOG

By Frederic Wood-Jones

The dog shares with the pig and the native rat the distinction of being above any suspicion of having been introduced into the Hawaiian Group by the white man. The Polynesians, whatever their continental place of origin, were in possession of these three mammals when their migrations through the islands of the Pacific were undertaken. All three animals were regarded as articles of diet by some of the scattered branches of the Polynesian race, and it was for its flesh, rather than as a house guard, companion or hunter, that the dog was esteemed by the Hawaiians. This fact accounts for the peculiar circumstance that the dog was kept and fed—not as a pet, but as an animal to be fattened up in readiness for a feast. In the Hawaiian islands dogs were reared for food and specially fattened as a general custom shared in by all classes; but in Tahiti (Ellis, 1929, Polynesian Researches, vol. 1, p. 351) they were regarded more as an article of luxury and were eaten principally by the chiefs. For the purposes of fattening them for the table they were fed upon a vegetarian diet. "They have few of the characteristics of the English dog," Ellis reported in 1829, and he adds—"this probably arises from their different food." Darwin also noted that the dog of the Polynesians had suffered some degeneration of its intelligence owing to the circumstance of its being regarded merely as an article of diet.

Unfortunately there appears not to be any very detailed description of the native Hawaiian dog, written by a good observer, at a time when we might expect that no influx of the white man's dog had contaminated the purity of the breed. In general, however, we know that it was a long-bodied, short-legged dog of the short-haired terrier type. In general build it has been likened to the dachshund but, unlike this breed, its large ears were held erect. The tail was carried with an upward curve and the coat color appears to have been varied; but white and pale yellow are said to have been predominant. The fore limbs are described as being bandy, and it is said that very commonly one leg was markedly more bent than the other. Although the pure breed has ceased to exist in the islands of the Hawaiian group, there is abundant evidence of the persistence of its blood in the large number of long-bodied, short bandy-legged mongrels to be met with even around Honolulu. At times it would seem that the combination of characters, said by the old Hawaiians to be typical of the poi dog, is very faithfully re-

produced in dogs of extremely mixed ancestry. It is by no means uncommon in Hawaiian villages to meet with these long, low dogs that have an unfamiliar appearance in consequence of their large erect ears.

Fortunately crania of the original dog are obtainable, for it was the occasional custom of the old Hawaiians to bury a dog along with its

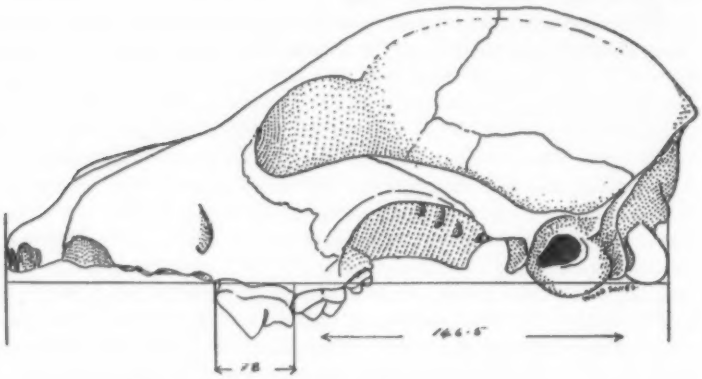

FIG. 1. SKULL OF HAWAIIAN DOG (SPECIMEN A). LATERAL VIEW

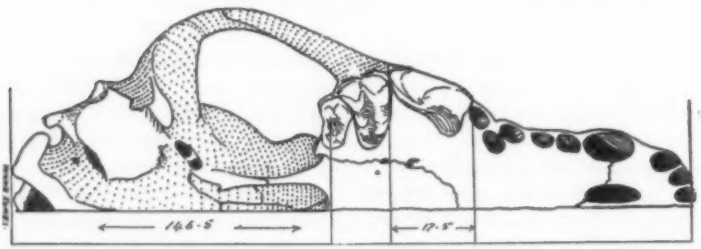

FIG. 2. SKULL OF HAWAIIAN DOG (SPECIMEN A). BASAL VIEW

human owner. Two such skulls of undoubted antiquity have been examined. The first skull (A) is that of an adult dog taken from a burial cave at Nuololo Flat, Kauai. The second (B) is from Nuololo Valley, on the same island, and is that of a young animal. Specimen B is in the collection of the Bishop Museum, to the authorities of which institution I am indebted for permission to examine and describe it. In

both cases the dogs had been wrapped in tapa before burial, and specimen B was included as a separate bundle in the general wrappings of a child.

The most conspicuous feature of the skull of the Hawaiian dog is the rounded and smooth contour of all parts of the cranium. The temporal lines are hardly visible; they are separated by an interval of nearly 30 mm. at the vertex, and the skull is therefore entirely devoid of a sagittal crest. The supraorbital processes are roundly convex and blunt. The muzzle is short and rounded, and the palate short and broad. The posterior margin of the palate is in line with the hinder portion of the last molar tooth. Combined, however, with the rounded cranium and other "pet dog" characters is the relatively great length of the carnassial tooth. It would seem that the major features of the cranium of the Hawaiian dog were impressed upon it by the nature of its soft vegetarian diet and that the feeding habits had produced very notable modifications in the skull of a type of dog that was yet possessed of teeth of primitively large size. The cranial adaptation in response to modified use of the jaws in mastication appears to have preceded any alteration in the character of the teeth, a condition to which the present writer has previously called attention in the case of captive lions (Proc. Zool. Soc. London, 1918).

The Hawaiian dog, judged from these two ancient specimens, may, therefore, be assumed to have been of the short-legged terrier type, still retaining the large teeth of the primitive lupine ancestor, but altered profoundly in its cranial characters by the imposition of a diet of soft vegetable food.

Cranial measurements of two ancient Hawaiian dogs, A and B: condylobasal length, 146.5 mm. and 139.5 mm.; maximum length, 156 and 148; interorbital constriction anterior to process, 30 and 26.5; interorbital constriction posterior to process, 38 and 36; breadth across supraorbital process, 44 and 38; bi-zygomatic, maximum, 86 and 78; breadth of brain case at temporal suture, 55 and 54; length of palate, 79 and 76; breadth of palate outside canines, 34 and 32; maximum breadth of palate, 56 and 55; nasals, lateral length, 56 and 48; nasals, medial length, 48 and 43; nasals, maximum breadth, 15 and 14; upper carnassial, maximum length, 18 and 17; post-canine dental length, 56.5 and 54.5.

REPRODUCTION IN THE EASTERN SKUNK (*MEPHITIS MEPHITIS NIGRA*)[1]

By H. M. Wight

During the past two years the writer has been engaged in a study of the animal life on a wild life sanctuary. The study was designed to determine the interrelations between the higher forms of life, including the game birds and mammals, the predatory birds and mammals, and the rodents and their relations to their environment. One of the most important and difficult problems in connection with this study has been the determination of the normal activity of the individuals of the various species under varying physiological conditions. This has involved much that must be regarded as pure life history investigation in order to build a foundation for other phases of the work.

The dearth of scientifically sound information on even our most common mammals is surprising in view of the fact that zoologists have been active in life history investigation since before the time of Aristotle. The lack of such information is daily felt by the field worker, and necessarily retards the progress of both economic and ecological investigators who must go back to the beginning and study biological phenomena which one might suppose to be well known. This paper is an account of observations on the mating habits of the eastern skunk, and illustrates the ease with which certain apparently difficult observations can be made.

Although the writer has kept many skunks in captivity during the past fifteen years and has had as many as fifty under observation at one time, the activity during the breeding period, or any information regarding the gestation period gathered through personal experience, has previously been of an indefinite nature. This was principally due to the fact that mating occurred within dens of complex construction. Seton[2] (1928) seems to have experienced the same difficulty, for he says "As the coupling will take place in the den and nearly always at night, the observation is not easy." He states that "The period of gestation is nearly always 63 days—9 full weeks," but that "in the experiments carried on at Saratoga Springs, New York, by the Department of Agriculture they have found various extensions up to as high as 72 days."

[1] Contribution No. 17 from the School of Forestry and Conservation, University of Michigan.

[2] Seton, Ernest Thompson, 1928. Life Histories of North American Game Mammals.

It was the writer's experience in Oregon that the mating period, which was indicated by sounds that emanated from the dens, occurred between March 1 and 15, and that the young usually were born during the second week in May, and most frequently on the 10th or 11th of that month. On the night of May 11, 1920, nine of the twelve females under observation at the time gave birth to young. This is remarkable, because of the fact that they were mated after the usual method of placing a male in a pen with six females. This uniformity indicates either an unusual coincidence based upon variation in the individual periods of gestation; a definite and brief period when conception actually takes place; or varying degrees of retention of spermatozoa following insemination before impregnation occurs.

Observations in the field also indicate that the impregnation may occur during a very brief season. For instance, on June 16, 1929, four litters of young skunks were observed, three of which appeared to be exactly the same age. A pair of these were kept by the writer, and throughout the fall and winter they were constantly observed in hope of determining something regarding the nature of hibernation, as the term is applied to skunks, and with the anticipation that definite information might be obtained regarding their activity during their breeding period.

The skunks wintered in a two-foot excavation made by themselves through a hole in the bottom of their large box, which was partly filled with dirt. This gave them an approximately normal winter den. Here they remained comparatively inactive until the latter part of February, although they usually came out of the burrow daily to take food.

On February 25 the writer's attention was attracted by the calls which are typical during the breeding season. On the morning of February 27, the tracks of a visiting wild skunk, attracted presumably by the female within the box, were found on the freshly fallen snow about the den of the captive skunks. This skunk had attempted to enter the box and had been successful in tearing a good-sized hole in its veneer side but had not gained entrance. At that time the captive female was in the pro-oestrous phase of the oestrous cycle.

In order to observe them more closely the pair were immediately removed to the basement and placed in a large open box where observations could readily be made at any hour of the day. In doing this the writer's assistant permitted the skunks to fall, but in spite of this accident an attempted mating occurred immediately following their introduction into the box.

During the following eight days nineteen matings were attempted

and the exact nature of the process and any variations as they occurred were recorded. From these records it has been possible to divide tentatively the sexual cycle of the skunk into the pro-oestrous, oestrous, and post-oestrous periods.[3]

THE PRO-OESTRUM

The pro-oestrous period was first indicated as mentioned above on February 25 by the complaining cries frequently made by the female and presumably resulting from the male's attempts at mating. This period terminated on February 28, and coition first occurred on March 1.

Our knowledge of the carnivores generally leads us to believe that the male is attracted to the female through the nature of the odor emitted during the pro-oestrum. This phase of the cycle, however, was not characterized in this skunk by any external evidence of a sanguineous or mucous discharge, nor was there any apparent swelling of the vulva. The presence of a visiting skunk about the cage on the night of February 26 indicated, however, that odor might have been the stimulating factor although the cries of the female could readily have attracted him to the cage.

Five observations of attempts to mate were made during this period, the first on February 27, at 1 p.m. It was surprising that the sudden removal of these animals from an underground den to an open box did not appear to affect their activity. During the entire pro-oestrous and oestrous periods the presence of the observer seemed in no manner to interfere with their normal reactions, which indicates the intensity of the stimulus and nature of the response.

In each attempt the male sought the female, and throughout the entire cycle there was no evidence that the female actively assumed an initiatory attitude. Each mating attempt began by the male's engaging the female in a struggle which from all appearances was exceedingly ferocious. They would lie upon their sides, curled about each other, and apparently attempting to bite one another, the female uttering her complaining call. The biting was, however, little more than a gesture. During this process the male would suddenly make a dash and catch the female by the skin of the neck close to the head. He then quickly clasped her about the abdomen with his front legs. This act was invariably followed by a rapid scratching movement with his hind foot which was at first interpreted as an attempt to force the female to extend herself in a position similar to that taken by the rabbit during coition. But it was soon determined that the foot was directed to the region of the vulva, and repeated observations left no doubt but that this process was a normal titilating act preliminary to copulation. An examination revealed the penis to be extended and erected. It was about an inch and a half in length and exceedingly slender, being no thicker at its distal end than the lead of a pencil and increasing but slightly in size back to the sheath.

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[3] The terminology used is after Marshall, Francis H. S., 1922, Physiology of Reproduction, Longman's Green & Co., London, except that the post-oestrum has been added to designate that important period immediately following the oestrum in the pregnant female.

The length of the mating attempts varied from five to ten minutes throughout the pro-oestrum, and terminated when the male voluntarily left the female without copulation having been completed.

THE OESTRUM

The oestrous period was characterized in this skunk by a swelling of the vulva; the receptive attitude quickly taken following titilation; and successfully completed coition.

Seven attempts to mate were made during this period, five of which were under continual observation, and all of these were successful. The first occurred on March 1 at 4 p.m. When the animals first came under the writer's observation the male held the female by the skin of the neck, and ten minutes passed before any very decisive attempt at copulation was made. She frequently dragged him to the center of the cage where she daintily ate some meat. He would invariably release his hold from her neck and examine her activity, and after dragging her away from the meat would then renew his struggles with added vigor. Suddenly the titilating act became unusually vigorous and for the first time the female pulled back her feet and elevated her tail, assuming a receptive attitude. With the beginning of copulation both fell on their sides, where he continued his mating movements for nearly a minute. While lying on the right side the male clasped the female about the abdomen with his front legs and with his upper hind foot held the female's upper leg well forward.

The periods of successful mating varied in duration from five to twenty minutes, the last successful mating on March 3 at 7 p.m. requiring but five minutes. This mating was noticeably different from the others in several respects. The initial struggle was brief, the titilating was but momentary, and the mating terminated in a manner not previously observed. The female began to growl and struggle before being released by the male. The nature of either the growl or the struggle apparently stimulated the male to assume a cautious attitude and from that moment on he was constantly on his guard. After backing off he carefully turned about, back to her, and actually by moving backward drove her into a corner. He then began to preen himself excitedly and thoroughly, lying on his back, scratching himself well up on his belly and even between his hind legs. This response was very evidently not entirely associated with mating as it had not occurred previously. It appeared much like the preening carried on by the pocket gopher following fighting. The female was not as active in her preening as was the male, but it was also the first observation of her preening following mating and was, therefore, noticeable. This change apparently indicated the end of oestrum and the beginning of the post-oestrum.

THE POST-OESTRUM

The post-oestrous period was characterized by a marked change in the reactions of both the female and the male. The female assumed an increasingly antagonistic attitude toward the male, who became increasingly cautious. Her vulva remained slightly congested throughout March 4, but the swelling had largely disappeared on the following day.

The male was unable to engage in open combat as the female laid upon her

back and fought off his approach. He was frequently able to grasp her by the neck, but her fighting was so constant and decisive that copulation was made impossible, although she continued throughout March 4 to react positively to the titilating process.

The fighting became more intense in nature on March 5, the most ferocious combat occurring at 8:30 p.m. and lasting for twenty minutes. The female continued, by lying on her back, to fight off every attack of the male in spite of the fact that he apparently utilized every strategic move that his instinctive repertoire could advance. His strongest offense was built up around his method of pressing his hip against her face as she laid upon her back and burrowing his head under her body. Whether this was an attempt to work his way well beneath her body and then by suddenly rising, to dislodge her from her defensive position upon her back was not definitely determined because the struggle became so fast at a certain point that it was impossible to follow it. He frequently was successful in catching hold of the skin of her neck, but she struggled so hard and so continually that he always was forced to release his hold.

Suddenly the female became decisively the aggressor. With growls, snarls, and threatening pattings of the floor with her front feet she drove her mate into a far corner. During this spurt of aggressiveness she bit him quite severely, causing him to cry out with pain. He was not satisfied, however, and immediately attempted to back up to her, when she nipped him again. Then he became excited and attempted to climb out of the box but failing in this, he finally showed indication of becoming cowed, and crouched down at a proper distance from her. It is possible that he would have left the den at this period, and perhaps both of them would have left—she to seek secluded quarters and he to find another female.

When visited again at midnight it was found that they had separated. One of the two pieces of woolen cloth which up to this time had been their common bed had been removed by the female to the opposite corner of the box and she was curled up asleep. He was not curled up, however, but still maintained a watchful attitude. Thereafter quarreling continued at infrequent intervals up to March 7, but the female appeared to lose gradually her extremely belligerent attitude and finally assumed a firm but friendly relationship toward the male. On the evening of March 7, they were found sleeping in the same nest, although not in the spirit of abandonment which had been customary previous to the mating period. For about a week longer the male showed evident signs which indicated his desire to mate, but she remained in active control of the relationship until they were finally separated.

During his earlier experiences with skunks, the writer lost two males through infection caused by injury to the head, and one male skunk was so severly injured that it caused blindness in one eye. This was probably due to bites inflicted by the females during the post-oestrum. This was entirely unnecessary and in the light of present knowledge it could have been avoided by removing the females at the proper time.

The female started to carry nesting material on April 15. At this time her teats showed plainly although there was no very evident enlargement of the mammary glands. By April 25 she had become extremely large, and the region about the vulva was noticeably swollen. She moved slowly and it was evident that her

young would soon be born. On the afternoon of May 2 she gave birth to a litter of seven.

Unfortunately it was inexpedient to separate the pair at the time of the first successful mating, which would have given definite information regarding the gestation period. But this would have terminated observations on the activity during the entire breeding period. Dating conception from the first successful mating the gestation was not more than 62 days. It will be possible, however, another spring to determine the period of gestation accurately by placing the females with the male for one mating during the oestrum.

SUMMARY

1. These observations indicate three definite periods during the oestrous cycle: The pro-oestrum which occurred from February 25 to 28; the oestrum from March 1 to 3, and the post-oestrum from March 4 to 7. The entire cycle lasted between nine and ten days.

2. The sexual cycle in the male precedes and extends beyond that of the female.

3. Completed mating occurred only within the period designated as the oestrum. Unsuccessful attempts were frequently made previous to and following this three-day period.

4. Peculiar massaging preliminary to mating caused the female to assume a receptive attitude.

5. Fighting during the post-oestrum became severe and indicated the advisability of separating the sexes early in the post-oestrous period.

6. The activity of the male indicated that the female is probably sought by the male

7. The loud and prolonged calls of the female during mating suggest that the mating usually if not always occurs in the underground dens, where the sound is deadened.

8. The activity during the post-oestrum indicated that in nature separation probably occurs at this time.

9. These observations provide information which in part at least explains the wandering instinct of the male during the breeding period, and hints at an interpretation of the tracks which frequently link several skunk dens during this period.

10. The period between the first mating and the birth of the young was 62 days.

11. The ease with which the observations were made and the marked activity observed indicates the skunk to be an animal well adapted for investigation of the physiology of reproduction.

THE DEER MOUSE, PEROMYSCUS, A VALUABLE LABORATORY MAMMAL

By Geo. T. McNair

It does not seem to be generally recognized that the deer mice (*Peromyscus*) are excellent laboratory mammals, probably with greater possibilities than any other of our wild mammals. Some species is to be found in practically every section of the United States. In fact, these mice are probably more numerous in this country than any other wild mammals.

In the vicinity of Lawrence, Kansas, two species of *Peromyscus* are found, *P. leucopus noveboracensis* and *P. maniculatus bairdi*. The former is by far the more numerous. It is primarily the methods of trapping and of handling these mice in the laboratory that will be discussed in this paper.

The best results in trapping have been obtained by placing the traps in the grass and weeds along fence rows beside cultivated fields or around an old wood pile that has not been disturbed for a season or so. From one such wood pile fifteen mice were caught on a single night in December and several others on succeeding nights. Both species were represented. In an uncultivated area where bluegrass had grown up several *Peromyscus* were caught, together with a large number of *Microtus*, two *Synaptomys*, several shrews and several house mice. Several authors in discussing our two species state that *leucopus* stays in the wooded territory and *maniculatus* in the open prairies. Although some trapping has been done in small, slightly wooded ravines, most of the specimens have been taken at the edge of grain fields and at least half a mile from any timber. Both *leucopus* and *maniculatus* were caught but *leucopus* (the wood-mouse) far outnumbered the *maniculatus*.

The traps used consist of a tin can wired onto a snap trap, a square of wire cloth being fastened to the spring so that when it snaps the wire cloth closes the end of the can. A piece of cotton or some blue grass is placed in the back of the can for a nest and some oats are thrown in for bait. Various other baits, such as oatmeal, mixtures of oatmeal and peanut butter, raisins, and bacon scraps have been tried, but the oats are much more easily handled and seem to bring the better results.[1]

It has been found that a considerable proportion of the mice die in the traps if they are left there for any great length of time, seemingly

[1] This trap, which is very inexpensive and very effective, has been described fully by W. H. Burt, Journal of Mammalogy, Vol. 8, No. 4, Nov., 1927.

having worried themselves to death. For this reason the traps containing mice are always collected early in the forenoon, and are brought directly to the laboratory, where the mice are placed in cages and mated immediately.

The cages used consist of a wooden frame covered with ¼ inch mesh wire cloth, and a galvanized iron bottom. They are 36 inches long, 15 inches wide, 10½ inches high at the back, and 2½ inches high in front. Two wooden partitions divide the cage into three completely separate cages. The doors, 6 inches square, are in the center of the sloping front. This type of cage is economical of space and it is easy to reach into to catch the mice. It is very seldom that the mice run up the sloping front to escape through the door. The bottom of the cage is covered with fine wood shavings. A can 4 inches in diameter and 3 inches high with a 1 inch door cut out at the bottom serves for a house. Holes are punched in the top for ventilation. For the most part fingerbowls have been used for water dishes. The food is placed in small trays on the floor of the cage.

For several months, at the beginning of these studies, the mice were kept in a greenhouse which has glass sides and roof. Although this building was also used for rearing guinea pigs and white rats it proved to be very unsatisfactory for *Peromyscus*. Some young were produced but few of them lived to maturity. There was also a high death rate among the adults. At least fifty per cent of the adults never produced young. The type of food was changed several times to determine if this was at fault, but this seemed to have very little effect, excepting that the death rate among the young individuals was lowered somewhat. Finally, since the temperature of the greenhouse was constantly higher than the out-of-doors temperature, about half of the cages were moved to the top floor of the Zoology building where it was much cooler and the light much more subdued. The two colonies were compared for a little over three months to determine whether the temperature factor was the essential difficulty. The new room is on the north side of the building. The cage racks were placed in front of a group of three north windows which were kept open. Later a large oscillating fan was kept running constantly. An immediate lowering of the death rate among the mice which had been moved was noticed, and before long an increase in the birth rate could be observed. Early in June, just beyond the peak of the breeding season, a check was made which showed that in the greenhouse only twenty seven per cent of the mice were breeding, compared with a fraction under fifty-eight per cent in

the cooler room in the Zoology building. In the greenhouse 4 embryos and 4 young were obtained while in the Zoology building 12 embryos and 16 young were obtained from a total of 25 pair of adults.

A high death rate among the young was still apparent even in the cool room. The young normally begin to shift for themselves at about the age of three weeks. They are generally removed from the parents' cage when about four weeks old unless other young have been born in the meantime, in which case they are removed immediately. A great many of them died when they were between three and six weeks of age. They developed a sort of paralysis in the hind legs and died usually within twelve hours.

Several types of food were tried. Some, these mice refused to eat at all. Others, and some of them rather complex mixtures, were seemingly satisfactory, but none was more satisfactory and more convenient to handle than a mixture of oats and oatmeal and a piece of carrot together with an occasional bone scrap or pellet of hamburger. Since starting this diet, no more paralysis has developed among the young and only very rarely has an adult died. Over-feeding has to be guarded against. The food trays are cleaned and refilled every other day. This is usually done late in the afternoon. A feeding for one pair consists of a small handful, probably two small tablespoons full each of oats and oatmeal and a slice of fresh carrot. The water bowls are washed out and refilled at each feeding. Fresh bone scraps are thrown in when the old ones have been gnawed completely clean.

Cannibalism is not unknown among these mice although it is rather rare. Only one or two possible cases have been found where adults were killed and eaten. If a strange male gets into a cage with some newly-born young he is sure to kill and devour them. The most frequent cases of cannibalism have been in cages where the young were three or four weeks old. It is assumed that it is the male that kills the young because in cases where only the female and her young were in the cage there has never been a case of cannibalism.

Considerable attention might here be given to the nervous temperament of these mice. They are not wild and erratic like house mice, even when frightened, neither are they as docile as the laboratory albino mice. Although some that have been reared in the laboratory are now in the fifth and sixth generations, they do not show any particular difference temperamentally from the wild ones just brought in from the field. It is always best to wear a pair of light gloves when handling them. Another rather interesting feature should be mentioned. On

a number of occasions when the house was raised for examination of the nest, as is done at each feeding, one or more of the young mice tumbled over dead, apparently from fright. In a very few cases they only fainted and after a few minutes recovered, when they jumped up and ran into the house and later seemed none the worse for the experience.

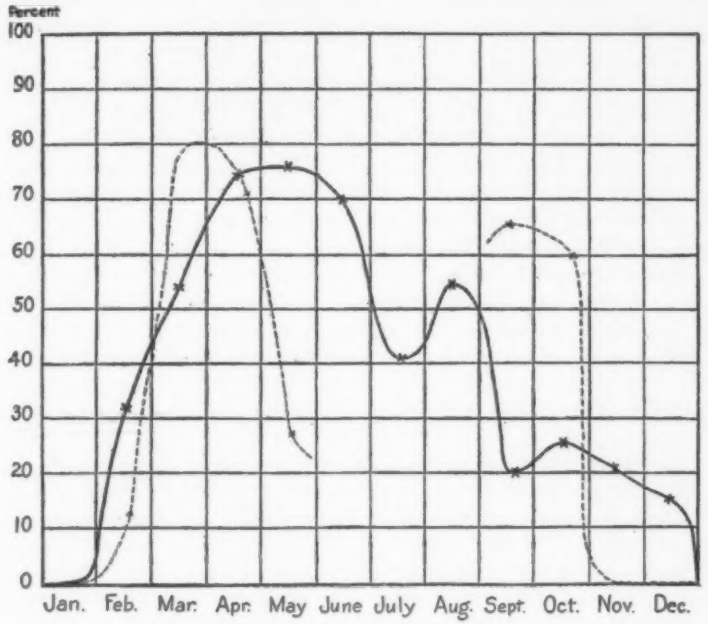

FIG. 1. Explanation of the graph.—The solid line shows the percentage of the total number of mature mice in the laboratory that were breeding each month in the year. The broken line shows the percentage of the total number of mature wild mice caught that were breeding. The cross marks on the curves represent monthly means.

In the laboratory the young begin to breed at ages varying from two and a half to several months. Those born in the spring usually produce young before fall, while those born in the fall seldom reproduce before the next spring. In the laboratory, young have been born every month in the year except January, although there are two periods when the rate is low, one during the heat of the summer and the other during

mid-winter. This seems to follow in a general way the fluctuations of the breeding activity in the wild state; however, from trapping records it would seem that the wild mice do not breed at all during the months of November, December, or January, and only a very few in February. Unfortunately no trapping records are available for the summer months. The appended graph shows the fluctuations of breeding throughout the year, both in the laboratory and in the wild state.

The data from which this graph is derived are the result of thirty months of continuous observation. The points on which the curves are drawn represent the percentages of the total number of female mice caught each month, or, of the total number of adult pairs in the laboratory which produced young or contained embryos during the month. These total numbers are of course variable. In the laboratory the totals are from twelve to forty pairs each month with a probable average of about thirty pairs throughout the period.

It will be noticed that a slightly higher rate of breeding was obtained in the laboratory. This is attributed to the fact that the conditions in the laboratory are more uniform throughout the year. The rather sharp drop in the curve during the month of July is due to the fact that the most prolific females were killed each year early in June to obtain embryos. The young that were born in the spring begin to breed during August.

One rather disconcerting fact about the breeding habits of these mice can not be explained at present. There is an irregularity of the oestrus cycle which makes it impossible to get embryos of a definitely known age. They are thought to mate normally every twenty-one to twenty-four days, or from twenty-four to forty-eight hours after the birth of the young. Records from this colony show variations of from one to ten days after the birth of young before mating occurred again. Since they are nocturnal mammals it has been impossible to get any information by observation concerning their mating.

In no case has any one pair produced young continuously throughout the year. Usually from two to four litters are produced and then a resting period of from one to three months follows. That this same condition seems to exist in nature can be seen on the graph where the distance above the curve represents the percentage of the total numbers caught which showed no indications of breeding.

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A NEW FORM OF MOLE FROM JUGOSLAVIA

By V. and E. Martino

Talpa romana stankovici[1] subsp. nov.

Type.—No. 537 Martino's collection, adult male, collected by V. and E. Martino. Aug. 26, 1928.

Type locality.—Magarevo Mts., Perister, S. Serbia (Macedonia). Alt. 1000 m.

Range.—Known only from the type locality.

Diagnosis.—A mole of the *Talpa romana* group. Dentition very robust, greatest diameter of M_1 3.7 mm. Maxillary tooth row about 40 per cent of condylobasal length, instead of 37 per cent, as in *Talpa europaea*. Size small; condylobasal length less than 35 mm.

Skull and teeth.—The skull is similar to that of *Talpa europaea*, but the rostrum above M_2 is relatively broad. The mandibular tooth row is short, but the length of three molars together is relatively large, about 7.5 mm.

Color.—The fur is slaty gray; the tail is concolor with the body.

Measurements.—Head and body, 114.0; Tail, 27.0; Hind foot, 16.4 mm. Skull: Condylobasal length, 33.5; zygomatic breadth, 12.8; breadth of brain case, 16.2; greatest interorbital breadth, 7.6; rostral breadth over canines, 4.2; rostral breadth over M_2, 9.7; mandible, 22.6; maxillary tooth row, 13.4; mandibular tooth row, 12.1 mm. Teeth much worn.

Remarks.—This new mole from the Perister Mountains is a relict form and a relative of *Talpa romana*. The small size is probably a result of life in rocky granite mountains.

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[1] The animal is named in honor of Mr. Siniša Stanković (Stankovitch), Professor in the University of Belgrade, well known explorer of relict faunas of the Balkan Peninsula.

ON SOME SOUTH AMERICAN CANINE GENERA

By Angel Cabrera

In Volume 11 of the Journal of Mammalogy (pp. 226–227), I find a note by C. W. Stiles and C. E. Baker, intending to designate "formally" the type-species of the South American canine genera *Cerdocyon*, *Lycalopex* and *Pseudalopex*. The opinion of the authors would be worthy of serious consideration, especially as one of them is in a high position with regard to nomenclatorial matters, were it not for the fact that, as it seems, they have missed an interesting paper published by Oldfield Thomas in 1914,[1] in which this lamented zoologist did the same thing, arriving at quite satisfactory, though different, results.

Cerdocyon, *Lycalopex* and *Pseudalopex* are considered by Stiles and Baker as synonyms, one and the same type (*Vulpes magellanicus* Gray) being selected for the three generic names. Thomas considered them as different, selecting as type-species *Canis azarae* Wied, for *Cerdocyon; Canis vetulus* Lund, for *Lycalopex*, and *Vulpes magellanicus* Gray, for *Pseudalopex*. These designations falling, in every case, on a species originally included under the respective generic name, Thomas acted quite in accord with Art. 30*g* of the International Rules of Zoological Nomenclature. Now, this article provides that "such designation is not subject to change."

Previously to the paper by Thomas, J. A. Allen[2] had synonymized the three genera, but he did not designate genotypes, and, moreover, it appears that he based his opinion on the misapplication of a specific name. And yet, it is "in order definitely to establish Allen's synonymy on an objective basis, and thus to safeguard it against change," that Stiles and Baker now intend to designate genotypes, ignoring (unintentionally, of course, the paper by Thomas being not even mentioned) that this had been done sixteen years before.

The genus *Cerdocyon* of Hamilton Smith contained originally four species, one of them (*C. mesoleucus*) unidentifiable, and a second (*C. guaraxa*) based on a drawing of a Brazilian crab-eating dog, the remaining two being *Canis azarae* Wied, which is the crab-eater of eastern Brazil (and not, as generally supposed, the agüarachai of Azara, or *C. azarae* of subsequent authors), and *Vulpes magellanicus* Gray, or the "culpeo" of southern Patagonia. Following the general opinion that *Canis azarae* was Azara's agüarachai, Allen considered these two species to be con-

[1] Ann. and Mag. Nat. Hist., ser. 8, vol. 13, pp. 345–363.

[2] Princeton Univ. Exped. Patagonia, vol. 3, pt. 1, 1905, p. 154.

generic; but from Wied's description and figure (the last bearing the name *Canis brasiliensis*) it is clear that his *azarae* was really a crab-eater, thus having nothing to do with the culpeo group. Thomas was free to select any of these very different animals as type of the genus, and he selected *azarae*, this designation invalidating that of *magellanicus* by Stiles and Baker. The fact that Hamilton Smith's *Cerdocyon guaraxa* is also a crab-eater, and very likely identical with Wied's *azarae*,[3] favors the selection of this last as the genotype. Ihering, in 1911,[4] said that "o typo mais conheudo" of *Cerdocyon* is *Canis brasiliensis* Schinz, but this can not be taken as a formal designation of type, and, at all events, *brasiliensis* being based on tha agüarachai of Azara, and this species being not included under *Cerdocyon* when this name was proposed, Ihering's opinion is utterly unacceptable.

Lycalopex was proposed by Burmeister as the name for a group of *Canis* in which he originally included two species, "*Canis azarae* aut." and *Canis vetulus* Lund. Two other species, *C. cancrivorus* and *C. magellanicus*, were referred to the same group in a footnote, but, the International Rules recommend that preference should be given to the best described species (Art. 30*n*) and to a species studied by the author of the generic name at the time he proposed it (Art. 30*q*). Thomas therefore very wisely designated as type one of the two species known by Burmeister at first hand. Now, "*Canis azarae* aut." of Burmeister is really a composite species, based partly on the true *azarae*, or east-Brazilian crab-eating dog, and partly on the very different agüarachai of Azara. The selection of the other species, *vetulus* Lund, was, therefore, a logical and almost unavoidable result. Gray in 1869, and Allen in 1905 had arrived, though by other ways, at the same conclusion, but the last author, on the ground that Mivart[5] considered *vetulus* a synonym of *azarae*, very naturally made *Lycalopex* a synonym of *Cerdocyon*. Allen further followed Mivart in considering the dog described as *vetulus* by Burmeister a species generically different from Lund's *vetulus*, and he included the first under a new generic name, *Eunothocyon*. Mivart's views were, however, quite wrong in this as well as in many other points

[3] Hamilton Smith used the vernacular name "guaracha of northern Brazil" for his species, but, it being based on the drawing of a specimen obtained by the Prince of Nassau's expedition, the term "northern Brazil" can be safely understood here as the Pernambouco district, the mammalian fauna of which does not differ from that of the zone in which Bahia, the type-locality of *azarae*, lies (See Osgood, Proc. Biol. Soc. Washington, vol. 28, 1915, p. 143).

[4] Rev. Mus. Paulista, vol. 8, p. 202.

[5] Monogr. of the Canidae, 1890, p. 73.

about South American *Canidae*, the *Canis vetulus* of Lund being absolutely different from *azarae* and inseparable from *vetulus* of Burmeister, as shown both by Winge[6] and by Thomas.

Stiles and Baker's selection of *magellanicus* as the type-species of *Lycalopex*, fortunately invalidated by the earlier designation of *vetulus* by Thomas, seems to me additionally questionable as against Recommendation *j* in Art. 30, which provides that "if the genus contains both exotic and non-exotic species from the standpoint of the original author, the type should be selected from the non-exotic species." The name *Lycalopex* being originally published in a book on Brazilian mammals, *Canis magellanicus* of southern Patagonia was there clearly an exotic species.

Pseudalopex was established by Burmeister in 1856 for three species: *Canis azarae*, *C. griseus* and *C. magellanicus*. The two last animals are really congeneric, both with each other and with the agüarachai of Azara, which in this case seems to be the chief basis of *azarae*. This group is, therefore, a very natural one. Thomas made *magellanicus* its type, this being the only instance in which the same view has been adopted by Stiles and Baker.

It is almost unnecessary to add that Thomas' designation of genotypes, implying the recognition of the three groups, whether as genera or subgenera, has been followed by mammalogists in general.[7] Quite recently, however, Kraglievich[8] has separated *magellanicus* and Azara's agüarachai from each other, retaining this last in *Pseudalopex* and including the first in *Dusicyon* of Hamilton Smith, and thus making the culpeo congeneric with *Dusicyon australis*, the Falkland dog, or "*Canis antarcticus*" of authors. According to the distinguished Argentine palaeontologist, his opinion is founded on the comparative study of the skull and tooth characters, but from his own text, it appears that the only tangible thing by which the culpeo resembles *Dusicyon* and differs from the agüarachai, consists in the relative size of the molar teeth. Now, in zoological classification, to rely upon a single dental character, disregarding all the other morphological features, means simply to revert to the conventional systematics of old times. Mammals (recent mammals, at least) are something more than teeth and skulls, and I wonder if any one having seen a specimen of the Falkland dog can believe in its

[6] E. Museo Lundii, vol. 2, pt. 4, 1895, p. 83.

[7] Pocock, Proc. Zool. Soc. London, 1914, pp. 920–923; Osgood, Proc. Biol. Soc. Washington, vol. 28, 1915, p. 143; Sanborn, Field Mus. Publ., Zool., vol. 17, 1929, p. 155; etc.

[8] Physis, vol. 10, 1930, p. 57.

identity with the culpeo group.[9] At all events, if the Patagonian culpeo and Azara's agüarachai were to be located in two different genera or subgenera, we should be compelled to get a new generic name for the agüarachai, as *magellanicus* is the type of *Pseudalopex*.

It was, no doubt, a very regrettable fault on the part of Thomas that he did not give any definition of the genera in question, some of these groups having never been properly characterized and the validity of their names resting as yet almost exclusively on that of their genotypes. It may be useful, therefore, to give here a tentative key to the four genera under discussion, with a list of the forms to be included in each genus.

KEY TO THE GENERA LYCALOPEX, CERDOCYON, PSEUDALOPEX AND DUSICYON

a. Muzzle short; facio-cephalic index[10] about 45. Carnassials small; length of p^4 hardly greater than length of m^1; length of m_1 about like length of $m_2 + m_3$. Upper molars subquadrate, very little extended transversely..... *Lycalopex*

a'. Muzzle long; facio-cephalic index 50 or more. Carnassials large; length of p^4 always much greater than length of m^1; length of m_1 always greater than length of $m_2 + m_3$. Upper molars much extended transversely.

b. Tail shorter, its length rather less than twice that of hind foot, and white tipped P^4 with protocone drawn backwards, facing the middle of main cusp; m_1 with metaconid placed conspicuously low, almost at level with cusps of talonid..... *Dusicyon*

b'. Tail long, its length always more than twice that of hind foot, and dark tipped. P^4 with protocone drawn forwards, facing the anterior base of main cusp; m_1 with metaconid placed high, its point almost at level with that of paraconid.

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[9] The unnaturalness of the single-character method of classification, which prevents me from adhering here to my colleague's opinion, is well illustrated by the fact that he includes also in *Dusicyon*, on the ground of the relative size of the cheek-teeth, the *Pseudalopex inca* of Thomas, a Peruvian fox which by all the other characters, cranial as well as external, is almost indistinguishable from Azara's agüarachai. In Kraglievich's opinion, the upper molar index (combined length of the two upper molars X 100, divided by length of carnassial) varies in *Pseudalopex* from 109 to 137, whereas in *Dusicyon*, including the culpeo group, it goes from 97 to 110; and yet, I owe to the late T. A. Wolffsohn, of Valparaiso, the photographs and detailed measurements of the skull of a male Chilean culpeo in which the length of p^4 is 14.5 mm., and that of both molars 19.3, the index being, therefore, 133.

[10] Facial length (as measured by Studer, Abhandl, Schweiz, Paläont. Ges., vol. 28, 1901, p. 3 = distance from posterior end of nasal to incisor alveoli) X 100, divided by basal length. I have found this index very convenient in the comparative study of dog skulls.

c. Feet with digital and plantar pads very large; interdigital webs little extensible; claws short. Skull with forehead high, the upper contour of braincase forming a conspicuous angle with the facial profile; molar with masseteric ridge of malar very near the lower edge. Mandible with condyle drawn upwards and angle very broad vertically..... *Cerdocyon*

c'. Feet with digital and plantar pads small; interdigital webs very extensible; claws long and slender. Skull with forehead low, depressed, the upper contour of braincase almost in line with the profile of the face; malar with masseteric ridge near the middle. Mandible with condyle drawn backwards and angle slender. *Pseudalopex*

Genus **LYCALOPEX** Burmeister

Small-toothed Dogs

Lycalopex Burmeister, Syst. Uebers. Thiere Bras., vol. 1, 1854, p. 95. Type by subsequent designation, *Canis vetulus* Lund.

Nothocyon Wortman and Matthew, Bull. Amer. Mus. Nat. Hist., vol. 12, 1899, p. 124 (not of Matthew, 1899).

Eunothocyon J. A. Allen, Princeton Univ. Exped. Patagonia, Vol. 3, pt. I, 1905, p. 152. Type, *Canis sladeni* Thomas, = *C. vetulus* Lund.

Lycalopex vetulus (Lund).

Canis azarae Lund, Bilk Bras. Dyrev., vol. 2, 1839, p. 91 (not of Wied, 1824).

Canis vetulus Lund, Forts. Bem. Bras. Dyrev., 1842, p. 4.

Canis fulvicaudus Lund, Blik. Bras. Dyrev, vol. 5, 1843, p. 20.

Lycalopex fulvicaudus, var. *chiloensis* Gray, Proc. Zool. Soc. London, 1868, p. 511.

Pseudalopex azarae Pelzeln, Bras. Säug., 1883, p. 55 (in part).

Canis parvidens Mivart, Proc. Zool. Soc. London, 1890, p. 108.

Canis urostictus Mivart, Proc. Zool. Soc. London, 1890, p. 112.

Nothocyon urostictus Wortman and Matthew, Bull. Amer., Mus. Nat. Hist., vol. 12, 1899, p. 125, fig. 9.

Nothocyon parvidens Wortman and Matthew, Bull. Amer. Mus. Nat. Hist., vol. 12, 1899, p. 126.

Canis sladeni Thomas, Proc. Zool. Soc. London for 1903, vol. 2 (1904), p. 235, pl. XXVII.

South-central Brazil: Minas Geraes, western São Paulo, Goyaz, Matto Grosso. Type locality, Lagoa Santa.

I am convinced, after examining the type of *Canis sladeni* in the British Museum of Natural History, that it is merely a semi-melanistic specimen of the very variable *vetulus*, normal individuals of which were collected in the same locality and at same time as the type. The dimensions of its skull are about like those of the largest specimens in the original series of Lund, and the presence of an extra upper molar is an anomaly without any taxonomic value, as recognized by Thomas himself.

Genus CERDOCYON Hamilton Smith

Crab-eating Dogs

Cerdocyon Hamilton Smith, Jardine's Natur. Libr., vol. 9, 1839, p. 259. Type by subsequent designation, *Canis azarae* Wied.

Thous Gray, Proc. Zool. Soc. London, 1868, p. 514 (not of Hamilton Smith, 1839).

Carcinocyon J. A. Allen, Princeton Univ. Exped. Patagonia, Vol. 3, pt. I, 1905, p. 153. Type, *Canis thous* Linné.

Cerdocyon thous thous (Linné)

Canis thous Linné, Syst. Nat., 12th ed., 1766, p. 60.

Viverra cancrivora Brongniart, Act. Soc. Hist. Nat. Paris, vol. 1, 1792, p. 115.

Canis cancrivorus Desmarest, Mammalogie, 1820, p. 119.

Thous cancrivorus Gray, Proc. Zool. Soc. London, 1868, p. 514.

Canis rudis Günther, Ann. Mag. Nat. Hist., ser. 5, vol. 4, 1879, p. 316.

Urocyon aquilus Bangs, Proc. Biol. Soc. Washington, vol. 12, 1898, p. 93.

Canis cancrivorus savannarum Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 8, 1901, p. 146.

Canis brasiliensis Goeldi and Hagmann, Bol. Mus. Goeldi, vol. 4, 1906, p. 63 (not of Schinz, 1821).

Lycalopex vetulus Studer, Mitth. Naturf. Ges. Bern, 1905, p. 2, figs. 4, 7, 10 (not of Lund, 1842).

Carcinocyon thous melampus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 30, 1911, p. 258 (not of Wagner, 1841).

Savanna and wood zone of northern South America, from tropical zone of northern Colombia to the mouth of the Amazon. Type locality, Dutch Guiana.

The status of some alleged subspecies of *C. thous* is not quite clear. Osgood,[11] for instance, has referred two specimens from Empalado Savannas, just east of Lake Maracaibo, to *savannarum* Thomas, the type of which came from the savannas of British Guiana, whereas Allen mentioned material from the upper Caura, in south-eastern Venezuela, and therefore nearer to the type locality of *savannarum*, under the name *melampus*, in spite of the fact that *melampus* was originally described by Wagner from the high plateau of Matto Grosso. Specimens from the river Culluny, also in Venezuela, were identified by Allen with typical *thous*, but without stating the way to distinguish them from those obtained on the high Caura. The same author, when showing that "*Urocyon*" *aquilus*, from Santa Marta, Colombia, was really a crab-eater, considered it as "a fairly well differentiated subspecies of *thous*," omitting again to establish the basis of this difference. Thomas, on the contrary, opined that *aquilus* may be identical with true *thous*, from the opposite end of northern South America. Such discrepancies are the more suggestive, as assumed local forms have been invariably described on one or two specimens only, and, as it seems, without direct comparison with topotypes of the typical subspecies. Now, color differences are of little, if any, taxonomic value in the crab-eating dogs, a good deal of variation being found even in the same locality, as shown by Allen for a series from Bonda, Colombia. As for skull measurements, those of the types of both *aquilus* and *savannarum* come very close

[11] Field Mus. Nat. Hist. Publ., Zool. Series, vol. 10, 1912, p. 59.

to either those of a skull from Cayenne figured by Blainville[12] or those given by Studer[13] for specimens from the island of Marajó. In view of these facts, I think the best course is to regard all the specimens of this species from the savannas and woods north of the Amazon basin as representing one, and the typical, subspecies. Some other races described from the mountain districts in the same region appear, however, to be worthy of recognition.

Cerdocyon thous germanus G. M. Allen

Cerdocyon thous J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 35, 1916, p. 224. (not of Linné, 1766).

Cerdocyon thous germanus G. M. Allen, Proc. Biol. Soc. Washington, vol. 36, 1923, p. 55.

High savannas of central Colombia. Type locality, savanna of Bogota (altitude, about 9,000 feet).

Cerdocyon thous apollinaris Thomas

Cerdocyon apollinaris Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 1, 1918, p. 371.

Eastern slopes of the Andes of Colombia. Type locality, Choachi (altitude, about 5,400 feet).

Cerdocyon thous lunaris Thomas

Cerdocyon thous lunaris Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 356.

Mountain district of southern British Guiana. Type locality, Moon Mountains.

Cerdocyon thous azarae (Wied)

Canis azarae Wied, Abbild. Naturg. Bras., 1824, text to pl. 23.

Canis brasiliensis Wied, Abbild. Naturg. Bras., 1824, pl. 23 (not of Schinz, 1821).

Cerdocyon guaraza Hamilton Smith, Jardine's Natur. Libr., vol. 9, 1839, p. 962, pl. XXVIII.

Canis melampus Wagner, Schreber Säug. Suppl., vol. 2, 1841, pl. XCII, E.

Canis brachyteles Blainville, Ostéogr. Mamm., vol. 2, Canis, 1843, p. 30.

Canis robustior Lund, Blik Bras. Dyrev., vol. 5, 1843, p. 33.

Canis melanostomus Wagner, Archiv. Naturg., vol. 1, 1843, p. 358.

Canis cancrivorus var. *brasiliensis* Burmeister, Erläut. Fauna. Bras., 1856, p. 31, pls. XXII, XXVII.

Pseudalopex azarae Pelzeln, Bras. Säug., 1883, p. 55 (in part).

Canis cancrivorus Winge, E. Mus. Lundii, vol. 2, pt. 4, 1896, p. 23 (not of Desmarest, 1820).

Canis thous angulensis Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 12, 1903, p. 460.

Eastern Brazil, from Cerará to São Paulo, westward to the plateau of Matto Grosso. Type locality, Bahia.

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[12] Ostéogr., Mamm., vol. 2, Canis, 1843, pl. VIII.

[13] Bol. Mus. Goeldi, vol. 4, 1904, p. 116.

Cerdocyon thous entrerianus (Burmeister)

Canis entrerianus Burmeister, Reise La Plata-Staat., vol. 2, 1861, p. 400 (♂ only).
Canis cancrivorus Burmeister, Descr. Phys. Republ. Argentine, III, 1, 1879, p. 143 (not of Desmarest, 1820).
Canis thous riograndensis Ihering, Rev. Mus. Paul., vol. 8, 1911, p. 217.
Cerdocyon mimax Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 355.
Cerdocyon thous fronto Lönnberg, Arkiv. Zool., vol. 12, no. 10, 1919, p. 13, figs. 3–5.
Cerdocyon tucumanus Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 7, 1921, p. 382.

Low savanna and wood zone of southern Brazil, Paraguay and northern Argentina, from south-western Matto Grosso to Entre Rios, and from central Tucuman to Rio Grande do Sul. Type locality, Parana, on the Parana river, Entre Rios.

In working out some *Canidae* from Uruguay, Thomas appeared inclined to refer Burmeister's *Canis entrerianus* to some other genus, on the ground that "Cerdocyons apparently do not occur in this region," but, aside from the question whether or not that statement is true, the type locality of *entrerianus* is not Uruguay, but Parana, in Entre Rios province, Argentina. Now, the type specimen of this name was definitely considered by Burmeister as a crab-eater, and, in fact, a form of *Cerdocyon* answering well to the original description is found in Entre Rios. Material of this origin exists in the National Museum of Buenos Aires, as well as in the Exposicion de Productos Enterrianos at the same town, and living specimens are frequently exhibited in the Buenos Aires Zoological Park. I can not distinguish these animals from others from Paraguay and Rio Grande do Sul (the last representing Ihering's *riograndensis*) in La Plata Museum, this material being in turn practically indistinguishable from the types of *mimax* and *tucumanus* which I have seen in London. All these names, as well as Lönnberg's *fronto*, have been based on single specimens, and founded on slight peculiarities of coloration or on insignificant cranial features, all the specimens coinciding in being of large size and coming from localities belonging to the low subtropical zone of savannas and woods which forms the basins of the rivers Parana and Paraguay with their tributaries.[14] It therefore seems necessary to regard all the names mentioned above as synonyms and to use *entrerianus*, as the oldest one, for this subspecies. Specimens from the mountains of Jujuy, westwards of the zone in question, may be provisionally considered as another race, although the material is too scarce to let us arrive at any definite conclusion.

Cerdocyon thous jucundus Thomas

Cerdocyon thous jucundus Thomas, Ann. Mag. Nat. Hist., ser. 9, VII, 1921, p. 382.

Hilly region of northwestern Argentina. Type locality, Sunchal, Sierra de Santa Barbara, Jujuy (altitude, about 3,400 feet).

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[14] In Argentina, this zone corresponds rather closely to the "Wald und Grasflur formation" of Kühn (Klute's Handbuch der Geograph. Wissensch., Süd-Amerika, 1930, p. 75, fig. 67), and also to the fourth ornithological zone of Dabbene (Anal. Mus. Nac. Buenos Aires, ser. 3, vol. 11, 1910, pp. 169–182).

Cerdocyon microtis (Sclater)

Canis microtis Sclater, Proc. Zool. Soc. London, 1882, p. 631, pl. XLVII.
Carcinocyon sclateri J. A. Allen, Princeton Univ. Exped. Patagonia, Vol. 3, pt. I, 1905, p. 153.[15]
Canis thous sclateri Ihering, Rev. Mus. Paul., vol. 8, 1911, p. 219.

Basin of the Amazons. Type locality, Amazons.

Genus **PSEUDALOPEX** Burmeister

Culpeos and South American Foxes

Pseudalopex Burmeister, Eriäut. Fauna. Bras., 1856, p. 24. Type by subsequent designation: *Canis magellanicus* Gray.
Pseudolycos Philippi, Archiv. Naturg., 1903, vol. 1, p. 157.
Cerdocyon J. A. Allen, Princeton Univ. Exped. Patagonia, Vol. 3, pt. I, 1905, p. 154 (from Hamilton Smith, 1839, in part).
Cercodocyon J. A. Allen, Princeton Univ. Exped. Patagonia, Vol. 3, pt. I, 1905, p. 154 (misprint for *Cerdocyon*).
Angusticeps Hilzheimer, Zoolog. Anz., vol. 30, April 1906, p. 114. Type: *Canis* (*Angusticeps*) *reisii* Hilzheimer.
Viverriceps Hilzheimer, Zoolog. Anz., vol. 30, April 1906, p. 116 (not of Gray, 1867; an evident *lapsus calami* for *Angusticeps*).
Microcyon Trouessart, Comptes Rendus Acad. Sci. Paris, vol. 143, December, 1906, p. 1186. Type: *Speothos riveti* Trouessart (= *Pseudalopex culpaeus reissii* Hilzheimer).
Dusicyon Kraglievich, Physis, vol. 10, 1930, p. 57 (in part; not of Hamilton Smith, 1839).

Pseudalopex culpaeus culpaeus (Molina)

Canis culpaeus Molina, Sagg. Stor. Chili, 1782, p. 293.
Canis magellanicus Waterhouse, Zool. Beagle, Mamm., 1839, p. 10, pl. V (not of Gray, 1836).
Canis amblyodon Philippi, Archiv. Naturg., 1903, vol. 1, p. 157.
Canis albigula Philippi, Archiv. Naturg., 1903, vol. 1, p. 159.
Pseudalopex culpaeus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 357.
Pseudalopex culpaea Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 7, 1921, p. 385.[16]

Central Chili, and the eastern side of the corresponding section of the Andes. Type locality, Chili. I suggest that it be restricted to the Santiago province.

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[15] The name *Canis microtis* was considered by Allen to be invalidated by *C. microtus* Reichenbach, 1846 (= *Vulpes velox* Say), but under the Code, Art 36, Recommendations, names differing only in termination or in a slight variation in spelling, though to be avoided, when once introduced can not be rejected on this account.

[16] Thomas used here a conventional feminine ending for the specific name, no doubt because *Pseudalopex* is feminine; but *culpaeus* being not an adjective, but a noun, from the araneanian "culpeo," it can be used in its masculine form in apposition with a feminine generic name, exactly as when we use *Capra hircus*, *Panthera pardus* or *Felis catus*.

Pseudalopex culpaeus andina Thomas

Canis azarae Tschudi, Fauna Peruana, 1844, p. 121 (not of Wied, 1824).
Canis culpaeus andina Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, March 1914, p. 357.
Canis culpaeus reisii Osgood, Field Mus. Publ., Zool., vol. 10, April 1914, p. 172 (not of Hilzheimer, 1906).

Andes of Peru, Bolivia and northwestern Argentina, southward to the Sierra de Anconquija. Type locality, Esperanza, Oruro province, Bolivia (altitude, about 13,350 feet).

There is in La Plata Museum a specimen from Cazadero, on the western slope of the Anconquija, quite indistinguishable from the type of *andina* by color, and only a little smaller in size. It seems, therefore, evident that this race extends southwards into the high mountains of the Catamarca province, being separated from the redder and even smaller *smithersi* of the Sierra de Cordoba by the extensive and low plains of La Rioja.

Pseudalopex culpaeus reissii (Hilzheimer)

Canis (*Angusticeps*) *reissii* Hilzheimer, Zool. Anzeig., vol. 30, April 1906, p. 114, figs. 3, 4.
Speothos riveti Trouessart, Comptes Rendus Acad. Sci., Paris, CXLIII, December, 1906, p. 1184.
Canis (*Cerdocyon*) *magellanicus riveti* Trouessart, Arc. Mérid. Equat., vol. 9, pt. 1, 1910, pp. A3, A12, pls. II–VIII.
Pseudalopex culpaeus reissii Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 357.

Andes of Ecuador. Type locality, Quito.

Pseudalopex culpaeus smithersi Thomas

Pseudalopex smithersi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 573.

Hilly zone of central western Argentina. Type locality, Sierra de Cordoba.

Pseudalopex culpaeus magellanica (Gray)

Canis magellanicus Gray, Proc. Zool. Soc. London, 1836, p. 88.
Vulpes magellanicus Gray, Mag. Nat. Hist., vol. 1, 1837, p. 578.
Pseudalopex magellanicus Gray, Proc. Zool. Soc. London, 1868, p. 512.
Canis montanus Prichard, Through Heart Patagonia, 1902, p. 260 (not of Marsh, 1871).
Canis (*Cerdocyon*) *prichardi* Trouessart, Catal. Mamm., Quinq. Suppl., 1905, p. 234.

Patagonia and southern Chile. Type locality, Port Famine, Straits of Magellan.

Pseudalopex culpaeus lycoides Philippi[17]

Canis (*Pseudalopex*) *lycoides* Philippi, Anal. Univ. Chili, vol. 54, 1896, p. 542.

Tierra del Fuego. Type locality, Tierra del Fuego.

[17] Under the Code, *Canis lycoides* Philippi is not to be rejected because of the existence of *Canis lycodes* Lund, 1843, notwithstanding the fact that λυκώδης and λυκοειδής were used in Greek only as variants of the same word.

Pseudalopex culpaeola Thomas

Canis azarae Aplin, Proc. Zool. Soc. London, 1894, p. 298 (not of Wied, 1824).
Pseudalopex culpaeola Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 359.

Uruguay. Type locality, Santa Elena, department of Soriano.

Pseudalopex gymnocercus gymnocercus (Fischer)

Procyon gymnocercus Fischer, Zoognosia, vol. 3, 1814, p. 178.
Canis brasiliensis Schinz, Thierreich, vol. 1, 1821, p. 220.
Canis azarae Rengger, Naturg. Saeugethiere Paraguay, 1830, p. 143 (not of Wied, 1824).
Canis protalopex Lund, Blik Bras. Dyrev., vol. 2, 1839, p. 32.
Vulpes azarae Gray, List Mamm. Brit. Mus., 1842, p. 60.
Pseudalopex azarae Gray, Proc. Zool. Soc. London, 1868, p. 512.
Canis (Pseudalopex) gymnocercus Osgood, Proc. Biol. Soc. Washington, vol. 28, 1915, p. 143 (in part).
Pseudalopex gymnocercus attenuatus Kraglievich, Physis, vol. 10, 1930, p. 54.

Paraguay, northern Uruguay and extreme southeastern Brazil, from Parana to Rio Grande do Sul. Type locality, Paraguay.

Kraglievich has shown that specimens of *gymnocercus* from south Brazil are markedly and constantly smaller than those from the Argentine pampas, evidently representing a different local race; but he is wrong in giving them a new name, as skull and teeth measurements published by Studer reveal the fact that the form inhabiting Paraguay, the type locality of the species, is the same as the one found in Brazil. This identity was, of course, to be expected from geographical reasons. For the Argentine race, the name *azarica* proposed by Thomas would be available, were it not for the fact that fossil remains quite indistinguishable from it have been previously described under other names.

Pseudalopex gymnocercus antiquus (Ameghino)

Canis azarae Waterhouse, Zool. Beagle, Mamm., 1839, p. 14, pl. VII (not of Wied, 1824).
Canis entrerianus Burmeister, Reis. La Plata-Staat., vol. 2, 1861, p. 400 (♀ only).
Canis protalopex burmeister, Anal. Mus. Publ. Buenos Aires, vol. 1, 1864, p. 141 (not of Lund, 1839).
Canis azarae, m. *fossilis* H. Gervais and Ameghino, Mamm. Foss. Amér. Mérid., 1880, p. 36 (not *C. familiaris fossilis* Pictet, 1853).
Canis azarae, m. *antiquus* Ameghino, Actas Acad. Nac. Cienc. Corboda, vol. 5, 1889, p. 298.
Canis azarai Lahille, Actas Prim. Congr. Cientif. Lat. Amer., 1898, p. 15.
Pseudalopex azarica Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 360.
Canis [Pseudalopex] gymnocercus Osgood, Proc. Biol. Soc. Washington, vol. 28, 1915, p. 143 (in part).

Pampas of eastern Argentina, southwards to the river Negro. Type locality, Luján, Buenos Aires province (in Pleistocene beds).

Canis incertus D'Orbigny and Laurillard,[15] from the Pleistocene of San Nicolas

[15] Voy. Amér. Mérid., vol. 3, pt. 4, 1842, p. 141, pl. IX, figs. 5 and 6.

de los Arroyos, Buenos Aires province, seems also very likely to prove to be identical with this subspecies, and if so, this name takes priority over *antiquus* by many years; but, it being based on a fragment of the jaw of a very young specimen, I do not dare to use it in this sense. The type specimen of Ameghino's *antiquus*, now in La Plata Museum, is perfectly identifiable and entirely like the living Buenos Aires fox. Two other names based by Ameghino on fossil remains have sometimes been included in the synonymy of *gymnocercus*, viz. *Canis ensenadensis* and *C. cultridens*; but *ensenadensis* is really a member of the genus *Cerdocyon* and may be an extinct southern form of *C. thous*, whereas *cultridens*, though certainly a *Pseudalopex*, is a small species coming near to the *gracilis* group.

Pseudalopex inca Thomas

Canis azarae Blainville, Ostéogr. Mamm., vol. 2, Canis, 1843, p. 26, pl. IV (not of Wied, 1824).
Pseudalopex inca Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 361.

Peru. Type locality, Sumbay, Arequipa (altitude, about 13,350 feet).

Pseudalopex gracilis gracilis (Burmeister)

Canis gracilis Burmeister, Reis. La Plata-Staat., vol. 2, 1861, p. 406.
Pseudalopex gracilis Gray, Proc. Zool. Soc. London, 1868, p. 513.
Pseudalopex patagonicus gracilis Kraglievich, Physis, vol. 10, 1930, p. 50.

Plains of western Argentina, from Santiago del Estero to Venquen. Type locality, outskirts of Mendoza.

Pseudalopex gracilis zorrula Thomas

Pseudalopex zorrula Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 7, 1921, p. 383.
Pseudalopex patagonicus zorrula Kraglievich, Physis, vol. 10, 1930, p. 51.

Low mountains of northwestern Argentina. Type locality, Chumbicha, Catamarca.

Pseudalopex gracilis domeykoanus (Philippi)

Canis azarae Gay, Hist. Chili, Fauna, vol. 1, 1847, p. 61 (not of Wied, 1824).
Canis domeykoanus Philippi, Anal. Univ. Santiago Chile, vol. 108, 1901, p. 168.
Canis rufipes Philippi, Anal. Univ. Santiago Chile, vol. 108, 1901, p. 168.
Canis maullinicus Philippi, Archiv. Naturg., 1903, vol. 1, p. 158.
Canis trichodactylus Philippi, Archiv. Naturg., 1903, vol. 1, p. 158.
Canis torquatus Philippi, Archiv. Naturg., 1903, vol. 1, p. 159.
Canis griseus Wolffsohn and Porter, Rev. Chil. Hist. Nat., vol. 12, 1908, p. 76 (not of Boddaert, 1784; not of Sabine, 1823; not of Gray, 1836).
Pseudalopex domeykoanus Cabrera, Trabajos Mus. Nac. Cienc. Nat., Madrid, vol. 31, 1917, p. 27.

Chile. Type locality, Copiapo.

The so-called different species of foxes from Chili described by Philippi in 1903 can be safely considered as mere synonyms either of this form, which is the "chilla" of the Chileans, or of *P. culpaeus culpaeus*. It has been, in fact, shown by Wolffsohn that the localities ascribed to them were only imaginary, all the material on

which Philippi based his paper having really been obtained within the limits of a "hacienda" near Santiago.[19]

Pseudalopex gracilis patagonicus (Philippi)

Canis griseus Gray, Proc. Zool. Soc. London, 1836, p. 88 (not of Boddaert, 1784; not of Sabine, 1823).
Vulpes griseus Gray, Mag. Nat. Hist., vol. 1, 1837, p. 578.
Canis patagonicus Philippi, Archiv. Naturg., 1866, vol. 1, p. 116.
Pseudalopex griseus Gray, Proc. Zool. Soc. London, 1868, p. 512.
Cerdocyon griseus J. A. Allen, Princeton Univ. Exped. Patagonia, vol. 3, pt. I, 1905, p. 157, pl. XXIII.
Pseudalopex patagonicus Kraglievich, Physis. X, 1930, p. 49, pl. IVb.

Patagonia. Type locality, Straits of Magellan.

Pseudalopex sechurae (Thomas)

Canis sechurae Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 5, 1900, p. 148.
Pseudalopex sechurae Kraglievich, Physis, vol. 10, 1930, p. 49.

Arid coastal zone of northwestern Peru. Type locality, Sechura Desert.

Pseudalopex fulvipes (Martin)

Canis fulvipes Martin, Proc. Zool. Soc. London, 1837, p. 11.
Vulpes fulvipes Gerrard, Catal. Bones Mamm. Brit. Mus., 1863, p. 88.
Thous fulvipes Gray, Proc. Zool. Soc. London, 1868, p. 514.
Canis azarae, var. *fulvipes* Mivart, Monogr. Can., 1890, p. 70, fig. 25.

Island of Chiloe. Type locality, Chiloe.

Genus **DUSICYON** Hamilton-Smith

Falkland Dogs

Dusicyon Hamilton-Smith, Jardine's Natur. Libr., vol. 9, 1839, p. 243. Type by subsequent designation, *Canis antarcticus* Bechstein (= *C. vulpes australis* Kerr).
Pseudalopex Gray, Proc. Zool. Soc. London, 1868, p. 53 (in part).

Dusicyon australis australis (Kerr)

Canis vulpes australis Kerr, Anim. Kingd., 1792, p. 144.
Canis antarcticus Bechstein, Penn. Vierfuss. Thiere, vol. 1, 1799, p. 271.
Dusicyon antarcticus Hamilton-Smith, Jardine's Natur. Libr., vol. 9, 1839, p. 252, pl. XXIII.
Pseudalopex antarcticus Gray, Proc. Zool. Soc. London, 1868, p. 531.
Canis australis Osgood, Journ. Mammal., vol. 1, 1919, p. 34.
Dusicyon australis Kraglievich, Physis, vol. 10, 1930, p. 57.

West Falkland Island (now extinct).

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[19] See the number of the Valparaiso newspaper "El Mercurio" for October 17, 1916.

Dusicyon australis darwini Thomas

Canis antarcticus Darwin, in Waterhouse, Zool. Voy. Beagle, Mamm., 1839, p. 10 (in part, not of Bechstein, 1799).
Dusicyon darwini Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 13, 1914, p. 352.
Dusicyon australis darwini Kraglievich, Physis, vol. 10, 1930, p. 58.

East Falkland Island (now extinct).

I think, both on geographical grounds and from examining the specimens in the British Museum, that Kraglievich is quite right in considering the two forms of Falkland dogs as local races of the same species, but I find it impossible to accept his opinion that this species is congeneric with the continental "culpeos."

La Plata, Argentina.

GENERAL NOTES

HABITS OF NEW YORK WEASEL IN CAPTIVITY

While trapping for meadow mice at Ann Arbor, Michigan, I captured an adult female weasel (*Mustela noveboracensis noveboracensis*) alive and uninjured on November 1, 1927. The spring-floor trap in which it was caught had been set in an old alfalfa field near a small drainage ditch, the sides of which were labyrinthine with *Microtus* runways. Several meadow mice had been caught here, and on the evening preceding the weasel's capture a live mouse had been removed from the trap. Having no bait with me, I reset the trap unbaited. Perhaps it was the fresh odor of meadow mouse that caused the weasel to investigate the trap and so get caught.

At this date cold weather had already set in and the ground was frozen solid. However, the weasel was still in its dark brown summer pelage with no sign of a change to its white winter coat. In the vicinity of Ann Arbor, only a small percentage of the weasels captured in winter show evidence of the white winter pelage.

The weasel adapted itself quite readily to captivity, spending most of the daytime curled up in its nest asleep. Sharp noises caused it to come out of the nest box to investigate. First it would poke its head and long neck out of the box and sniff the air, meanwhile raising its head up and down. If feeding time were near and it could smell a mouse, the weasel immediately became excited, running up and down the cage and emitting a loud hissing squeak, very like the noise made by a mink under similar conditions.

In killing mice, the weasel seized the prey with its teeth by the nape of the neck and bit through the base of the skull. This was usually accomplished while rolled over on one side with its fore feet firmly clasping the mouse and its hind feet scratching vigorously. Only a few seconds were required for the killing and usually the mouse had time to utter but one squeak.

When several mice were placed in the cage at one time, the weasel would kill one after another as quickly as possible and when this was done, search the cage for more. Back and forth it would go, licking its jaws and making a subdued hissing-blowing noise. If no more mice were found, it would then begin to feed upon one of those freshly killed.

At no time was the weasel observed to "suck the blood" of the mice. There is a prevalent idea that weasels are normally given to this habit. This has arisen perhaps from the general observations of poultry raisers who have had unfortunate experiences with weasels. The slaughter of hens resulting from a foray of one of these killers on the hen house, together with the fact that the victims are damaged merely by a bite on the back of the head, have led observers to conclude that the weasel sucked the blood and was satisfied. From my own observations of this weasel in captivity, it seems to me that it is the instinct of the animal to kill everything in sight before feeding. He enjoys the "sport" of securing a big bag of game, like his human relative, the "game hog." And can anyone imagine such a keenly alert and sensitive animal as the weasel settling down to a quiet chicken dinner until every noisily cackling hen is effectively silenced?

In its daily habits, the captive weasel was very cleanly. One corner of the cage was used for defecating and urinating purposes. Here the inedible parts of the mice, such as the skin and harder parts of the skull, were carried.

When intensely excited the weasel would stand upright on its hind legs with head at right angles to its body and front paws tucked close against its white breast. In this position it would emit the characteristic hissing-blowing noise. Another common habit was to drag itself along the floor of the cage on its belly with neck and chin outstretched in front and hind legs stretched out behind, pulling itself along by its forelegs.

During the winter months, the weasel remained very quiet and contented in the cage and made no attempt to escape. The brown summer pelage was retained throughout the winter. Towards spring, perhaps with the onset of the breeding season it became more and more active and restless. A heavy weight had to be kept on top of the cage so as to prevent the weasel's pushing out. Finally, on March 18, 1928, its attempts to escape were successful. The water bottle was pushed out. The weasel had squeezed itself through the one inch hole to liberty. —ARTHUR SVIHLA, *Chas. R. Conner Museum, State College of Washington, Pullman, Wash.*

REDWOOD CHICKAREE TESTING AND STORING HAZEL NUTS

The article in the Journal of Mammalogy of May, 1930, on Rejection of Wormy Nuts by Squirrels, by Wayne Dennis, brought to mind some notes that I had made in a previous summer concerning harvesting work done by the Redwood Chickaree (*Sciurus douglasii mollipilosus*). The scene of my observations was my camp in the Bohemian Grove (of redwoods), Sonoma County, California.

July 9, 1929, was the date of my arrival, very shortly after which the friendliness and doings of a chickaree, apparently a young one, were so interesting that I watched it rather closely for a while. At this date the hazel bushes in the partial clearing around my camp were bearing a larger crop of nuts than usual, and these were on the verge of ripening. There were several chickarees living around the immediate vicinity, as evidenced by the barking, chattering and other characteristic sounds that these little squirrels are so fond of making.

In a few days the squirrels began gathering the nuts, being very careful at first to select the largest and ripest. The morning sun is slow about getting into the narrow valley athwart which lies the grove and in the early chill the chickarees were especially active, chasing each other over the tent roof and across the platform with such ardor and racket as would have wakened even Rip van Winkle. As the days went by the squirrels became accustomed to my presence and one in particular, still immature looking, showed more friendliness than any other.

One morning this little neighbor was actively engaged in gathering hazel nuts, carrying them down the path leading from my tent, and disappearing behind an old redwood stump, where a store room had been located. When the sun had reached the valley I sat down by my tent to read a paper, my chair almost brushing against a low hazel bush well loaded with nuts. Soon my little squirrel friend came up the path, from the ground took a look at the hazel nuts and, running under my camp chair, climbed up into the bush beside me. Here he sat on a branch within arm's reach, quickly stripped the husk from a nut, and ran back with it to his storehouse. He went through this performance several times, but not in regular succession, often making an intervening trip to other bushes farther away. While he was close to me I did not make any rapid or extended motion, for fear of frightening him, but turning my head to watch him, or even moving the newspaper a little, did not disturb his equanimity.

When he was in this bush I noticed that there were certain of the nuts to which he climbed that he did not take, and that he would grasp these with his fore paws, put his nose to them, apparently making a contact for an instant, and then turn away. In no case was a nut gathered that had been so tested. Often on the other hand, the chickaree would look up from the ground, select a certain nut, climb straight to it and carry it off without a moment's hesitation or any examination whatever. From this mode of action it seemed that no suspicion as to the soundness of a nut was aroused until he was very close to it, but when any nut was suspected it would be instantly tested, as above described, and rejected.

The harvesting of the nuts on this bush was watched with great interest, particularly on account of its being all done within two or three yards of me as I sat in the chair. When the bush was stripped of all nuts sufficiently ripe at the time, I carefully examined the rejected ones. As regarded exterior appearance these seemed to be perfect but removal of the husk in every case exposed a worm-hole and strengthened my belief that there must be a recognizable odor to a wormy nut, perceptible to a squirrel within a very limited distance, and that the squirrel puts its nose to the nut to confirm its suspicion. By the time my observations brought me to this conclusion the squirrel had almost cleaned up the small bush by my chair and in a day or two its storehouse must have been filled up, for no more nuts were taken to it.

Shortly after this I saw either this squirrel, or another much like it, carrying nuts from a larger bush, where they were now rapidly ripening, down the same pathway but across the main road running past my camp. Walking near enough to see what was being done with the booty, I happened to stand with one foot on each side of the pathway and was rather surprised to see the squirrel, after stopping to examine me for a moment or so, from head to foot, pass on right between my feet and cross the road. Instead of storing nuts in a hole, however, this one was simply burying them in the dead litter under the maple and redwood trees.

At one time during these proceedings I husked some nuts and put a dozen or more, all sound ones, in the pathway, to see if the squirrel would be grateful for such assistance in its harvesting. This offering was utterly ignored, the squirrel most unconcernedly running right over the handful of nuts, on several occasions without paying the slightest attention to them, evidently preferring to do its own gathering and husking.

The summer of 1930 also showed a fair crop of hazel nuts and I anticipated some more observations on the chickarees during my vacation period, passing most of July in my camp. There were squirrels around and running over my tent as in the previous summer, but absolutely no sign of storing was noticed in my vicinity and but little gathering of nuts was seen. Possibly the hazel bushes higher up on the steep sides of the narrow valley were more attractive this summer than those on the valley floor.—Joseph Mailliard, *California Academy of Sciences, San Francisco, California.*

SPEED OF THE GRAY SQUIRREL

An unusual opportunity was afforded late in August of last year for measuring the speed of the common gray squirrel. I happened to reach a bridge over the Charles River near Dedham, Mass., just as a squirrel started to cross it on the gabled top rail of the left hand fence. Moving near the squirrel, I was able to pace it for some forty or fifty feet, and I found that it was running at the rate of exactly fifteen miles per hour. The car was new, and the reading of the speedometer was probably fairly accurate.—Austin H. Clark, *U. S. National Museum.*

AN INTERESTING BEAVER TRAIL

While collecting mammals in the Ashley National Forest in Daggett County, Utah, during the summer of 1929, I noticed an interesting example of beaver activity. At an altitude of 8,500 feet, a collecting station was made at Beaver Creek which flows through a mountain park surrounded by lodgepole pine forest. During trapping operations for small mammals on one side of the creek, I observed a well-marked trail leading up the slope through the sagebrush from the opposite side of the creek. Although sheep and cattle grazed through the park, none was ever seen on this particular trail which indeed differed from a sheep or cattle trail in that it led almost straight up the steep slope. A closer examination of the trail revealed aspen twigs and fresh beaver tracks in the mud at the edge of the creek where the trail began and which here had been dammed to form a good sized beaver pond. A fresh beaver lodge and green aspens on the dam showed that the beavers had been active the night before.

The trail led up the steep slope for about a hundred yards through the open sagebrush to a clump of lodgepole pines. The path, about two feet wide throughout its length, was smooth, well-worn, and clear of sagebrush. Numerous deep scratches in the hard dry clay soil showed that logs had been dragged down the trail. Dry leaves and aspen twigs were scattered along its length. No aspens were visible from the creek or lower end of the trail and the nearest known groves were two miles downstream. The trail was therefore followed with interest up the slope and through the clump of lodgepole pines. There, about fifty feet from the pines, the trail came to an abrupt end in a small grove of aspens. Although

only two trees remained standing, about fifteen stumps showed the past activities of the beavers. Some of the stumps must have been several years old for they were black and partly covered with moss. Others were still green, having been cut quite recently. One tree had been felled and was in the process of being cut into sections, several of which had already been carried off down the trail. At the edge of the aspen grove a clump of three-foot saplings were growing. These had not yet been touched by the beavers.

From the appearance of the well-worn trail and the old stumps, this grove of aspens had evidently been known to the beavers for a number of years.—ARTHUR SVIHLA, *Chas. R. Conner Museum, State College of Washington, Pullman, Wash.*

THE "BALD MOUSE," A GENETICAL ANOMALY

The writer recently placed on record a specimen of house mouse which exhibited a remarkable condition of hairlessness. The note attracted the interest of Dr. Clyde Keeler who, in a letter to the writer, states that: "From your description it is like the *Mus musculus* variety we are raising at Harvard University. The hairless character (naked as we call it) is due to a dominant gene and makes a completely naked creature if two doses are present."

The specimen was forwarded to Dr. Keeler for examination. Dr. Keeler replied, in part, as follows, "I have just received the hypotrichotic specimen of *Mus musculus* about which you published a note in the Journal of Mammalogy, Vol. 11, p. 233, under the title 'A bald mouse.' This is undoubtedly an animal bearing the dominant hereditary unit-character known to geneticists as 'naked.' The scars upon the body I judge to be due to parasites."

The writer is indebted to Dr. Keeler for a correct interpretation of this anomaly.—L. L. SNYDER, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

THE VOICE OF THE PORCUPINE

Mr. Charles Foster Batchelder's note on the voice of the Canada porcupine, in the Journal for May, 1930, pp. 237–239, recalled to mind an experience of my own with a young porcupine (*Erethizon epixanthum*) in the Yellowstone National Park in the summer of 1929, a brief account of which was published in the Yellowstone Nature Notes, Vol. 7, No. 4, p. 20, April, 1930.

The vocal ability of this particular individual was a revelation to me, as I also had the notion that porcupines were as "tightlipped" as some people, and the "remarkably human quality of its voice" impressed me as it did Mr. Batchelder.

This is shown by the following quotation from my published note: "Its most amusing trait was a peculiar little call somewhat like the crooning of a human baby. It seemed to make this noise most often when it was fed and getting sleepy. I have often seen it lying on its side apparently very sleepy, crooning and at the same time trying to chew on a rose bush in a half-hearted way."

This particular porcupine was observed to feed only on wild strawberry plants, short and tender wild rose bushes, and a coarse rank plant having a very juicy stem.—OTIS WADE, *Department of Zoology and Anatomy, University of Nebraska, Lincoln.*

PIKAS VERSUS WEASEL

On July 20, 1930, at Milner Pass on the Continental Divide in Rocky Mountain National Park, Colorado, the writer witnessed a race for life between a Dwarf Weasel (*Mustela streatori leptus*) and several Colorado Pikas (*Ochotona princeps saxatilis*).

During the morning, while I was trying to photograph a pika, I was surprised by a sudden barrage of alarm notes from numerous pikas on all sides of me. The outburst was so vehement that I felt certain that something unusual must be afoot. At the first alarm call all of the pikas in the vicinity immediately ceased foraging and scrambled up hastily to their lookout stations on the crests of slabs of granite, where they stood guard and anxiously peered about in every direction in an endeavor to locate some hidden enemy. At first I was unable to detect the presence of any potential enemy. Then suddenly a pika, closely followed by a streak of brown, flashed by between the rocks, almost at my feet. My first impression was that a chipmunk was chasing a pika, but a second glance showed that the "chipmunk" was a Dwarf Weasel in active pursuit of a two-thirds grown pika.

I had always believed that nothing could thread the maze of winding passages between the boulders of a rock slide quite as fast as pika can and does. However, I found myself mistaken, for the weasel could, and did, outrun the pika. It soon became obvious that the weasel could squeeze through any crevice that the pika could manage to get through, so that life and safety for the pika lay in its ability to dodge or otherwise to outwit the enemy. I watched the weasel closely at a distance of ten feet and found that it apparently followed the pika entirely by scent, dodging in and out among the rocks with unbelievable speed and following the winding course of the cony with ease and accuracy.

Then, when it seemed that the weasel was just about to capture the young pika, one of the old adult pikas suddenly left its lookout station (all of the pikas had remained at their lookout stations) and cut into the race, keeping ahead of the weasel and just behind the young pika, which was becoming exhausted and which dodged out of the race at the first opportunity.

My first thought was that the second pika, while in a panic of fear, had fled blindly and had accidentally gotten into the race, but while I watched, a third pika, distinguishable by a scar on its side, deliberately entered the race but was not successful in diverting the weasel's attention from the second pika, which was getting weary. A few moments later, a fourth pika joined in the relay race. By this time the weasel showed marked signs of fatigue and gave up the unequal contest.

The facts in this incident would appear to indicate that pikas at times may aid each other at critical moments in escaping a common enemy by forcing it to run a relay race against an overwhelming number of opponents.— JOSEPH DIXON, *405 American Trust Building, Berkeley, California.*

BALAENOPTERA ACUTOROSTRATA OFF MONTAUK POINT, NEW YORK

On August 16th of this year a small whale, about 25 feet long, was killed off Montauk Point, Long Island, towed to shore, and celebrated with a few paragraphs and its portrait in the rotogravure sections of most of the New York newspapers. This whale was considered to be a Common Finback, *Balaenoptera*

physalus. I went down to examine the creature, and was struck by the conspicuous white, and slightly sinuous, band across the dorsum of each of its flippers, a marking I had not noticed in the only Finback I have ever seen. I therefore drew some crude sketches of the whale, and counted its short, yellowish-white whalebone-plates, which numbered 300 on each side. At the first opportunity I looked it up in Jordan's "Manual of the Vertebrates," and decided that it was a Little Piked Whale, *Balaenoptera acutorostrata*. This identification was confirmed by Drs. J. T. Nichols and H. E. Anthony, at the American Museum of Natural History.

There seem to be few, if any, definite published records of this whale in Long Island waters, and not very many from southern New England.—William Tod Helmuth, 3rd, M.D. *Easthampton, Long Island, New York.*

WHALING STATISTICS FOR THE PACIFIC COAST OF NORTH AMERICA

During the years 1919 and 1920, the whale fisheries operating along the Pacific Coast of North America supplied about one-tenth of the total world output of whale oil. Satisfactory yields of whale oil were obtained by the Pacific whaling companies in both years, but a large carry-over of surplus stocks, coupled with depressed prices, resulted in suspension of operations at some of the stations in 1921. The prices offered for whale oil in that year were reported as being lower than the production costs. Operations were again resumed in 1922 and the oil yield during this year was slightly less than in either 1919 or 1921. With the tremendous expansion of this industry in Antarctic waters, production of whale oil steadily increased and in 1923 the estimates for the entire world indicated a yield more than twice that of 1919; while the world yield of 1929 was more than five times that of 1919. Whale oil production by the companies operating along the Pacific Coast of North America has fluctuated from year to year, and with the increase in world production the ratio of the yield in this region to that of the whole world has steadily declined. During 1929 the Pacific Coast of North America produced about one-fortieth of the world total.

The following table not only furnishes a picture of the annual fluctuation in the catch of the different kinds of whales, but also provides figures for a year to year comparison of the catch in each of the geographical units. In the interval between 1919 and 1929, Humpbacks comprised nearly one-half of all the whales that were caught, Finbacks about one-fourth, Blue whales about one-eighth, and Sperm whales approximately one-twelfth. The statistical data incorporated in this table is based upon the Annual Reports of the U. S. Commissioner of Fisheries and upon the unpublished annual reports of the respective whaling companies. For permission to include data contained in the companies' reports, I am indebted to the Chief Supervisor of the Department of Marine and Fisheries, Fisheries Branch, Vancouver, B. C.; Mr. William Schupp of The American Pacific Whaling Company, Seattle, Washington; Dr. Barton Warren Evermann, Director of the California Academy of Sciences, San Francisco, Calif.; Mr. N. B. Scofield, in charge of the Bureau of Commercial Fisheries, Division of Fish and Game, San Francisco, Calif.; Mr. Milton J. Lindner of the California State Fisheries Laboratory at Terminal Island, Calif.; Mr. Stedman H. Gray, editor of the Pacific Fisherman; and Mr. Gunnar Jahn, director of the Norwegian Statistical Central Bureau at Oslo, Norway.

YEAR	LOCALITY	BLUE	FINBACK	HUMPBACK	SEI	GRAY	SPERM	MISCELLANEOUS	TOTAL NUMBER OF WHALES	OIL PRODUCTION IN BARRELS
1919	Alaska	68	242	132	2		95	41[1]	580	25,048
	British Columbia	37	217	65	74		35	4[2]	432	12,194
	Washington	1	26	122	5		19	1[3]	174	5,200
	California	2		223			3		228	6,318
1920	Alaska	81	179	75	4		90	236[4]	665	22,178.4
	British Columbia	26	149	98	121		56	43[5]	493	12,081.4
	Washington	1	22	138	12		14		187	4,024.5
	California		15	383	1		1		400	11,070
1921	Alaska		2	75		1	1	50[6]	129	1,140
	British Columbia[21]									
	Washington[21]									
	California		13	124		1	1		139	7,087.4
1922	Alaska	77	204	95			69		445	18,087
	British Columbia	4	94	50	1		38		187	5,666.3
	Washington	1	27	124			9	2[7]	163	5,330
	California		5	600		5	1		611	18,401
1923	Alaska	29	151	155	1		16	3[8]	355	13,105
	British Columbia	62	166	78	53		94	4[9]	457	18,130.3
	Washington		23	99			14		136	4,600
	California		15	792			1		808	12,456.8
1924	Alaska	46	148	71			17	1[10]	283	12,664
	British Columbia	56	125	47	100		83	4[11]	415	12,913
	Washington		68	98	2	1	5		174	4,133
	California	1	21	197					219	7,819
1925	Alaska	36	234	208			33	1[12]	512	19,265
	British Columbia	29	135	40	68		76	3[13]	351	11,138.8
	Washington			21					21	610
	California		37	43			2		82	4,368.8
	Lower California	220	1	493	45	140	4		903	24,400
1926	Alaska	16	177	388			1	2[14]	584	20,142
	British Columbia	14	124	25	25		80	1[15]	269	9,364
	Washington[22]									
	California		69	21	25	1	1		117	5,126.3
	Lower California	239		498		42	3	34[16]	816	29,100

YEAR	LOCALITY	BLUE	FINBACK	HUMPBACK	SEI	GRAY	SPERM	MISCELLANEOUS	TOTAL NUMBER OF WHALES	OIL PRODUCTION IN BARRELS
1927	Alaska	35	122	554	3		3	1[17]	718	22,328
	British Columbia	10	138	21	7		82		258	8,759.3
	California	11	42					256[18]	309	6,818+
	Lower California	153	2	472	45	29	3		704	26,425
1928	Alaska	51	98	220	1	2	24	6[19]	402	16,488
	British Columbia	45	138	21	13		83	1	301	11,438.3
	California	105	185	10	12	1			313	12,677
	Lower California	207	1	179	3	9	2		401	17,600
1929	Alaska	53	105	214			12	1[20]	385	16,669
	British Columbia	16	168	9	67		146	1	407	6,553.7
	California	75	149		9				233	7,302.2
	Lower California	187	2	23	5	2			219	13,900
Totals		1,994	3,839	7,295	704	234	1,218	696	15,985	530,120.5

[1] 41 Belugas. [2] 4 Species unknown. [3] 1 Species unknown. [4] 236 Belugas. [5] 43 Species unknown. [6] 50 Belugas. [7] 2 Species unknown. [8] 2 Bowheads, and 1 Right whale. [9] 2 Bottlenose and 2 sharp-headed finbacks. [10] 1 Right whale. [11] 3 Right whales and 1 Bottlenose. [12] 1 Right whale. [13] 3 Bottlenose. [14] 2 Right whales. [15] 1 Right whale. [16] 34 Bryde whales. [17] 1 Right whale. [18] 1 Bottlenose, and 255 Species unknown. [19] 6 Right whales. [20] 1 Right whale. [21] No plants operated. [22] Plant dismantled.

The Blue whale or Sulphurbottom attains the largest size of any of the recent whales, and commercially it is the most valuable species on account of the large yield of oil. In case of whales taken in California waters, a marked variance in the individual yield of oil has been noted. Occasionally some very large Blue whales are taken which produce very little oil, and in the parlance of the whalers are called "dry skins," while others yield as much as 100 barrels. As a general rule a yield of 50 barrels is expected from those taken in California waters and 75 barrels in Alaska waters. The bulk of the annual catch of Blue whales comes from the coastal waters of Lower California, Alaska, and British Columbia. The Finback is second in size and forms an important part of the catch everywhere along the Pacific Coast except Lower California. Finbacks taken in California waters yield on the average about 42 barrels per whale while the Alaska stations reckon the average return at about 40 barrels. The Humpback for a numbers of years outnumbered any other species in the annual catch, although the oil yield is not especially high in these waters. A yield of 33 barrels is generally expected of Humpbacks taken off the California Coast, while at the Alaska stations the average yield is about 30 barrels for an adult whale. Sei whales are most frequently

taken off Lower California and British Columbia, and seem to be quite rare near the Alaska stations. A Sei whale ordinarily yields about 20 barrels of oil in California waters. A closely related species, the Bryde whale, appears in the returns made by the Norwegian companies operating off Lower California. Assuming that this identification is correct, it is likely that some of those listed as Sei whales in the reports furnished by stations located elsewhere along the Pacific Coast have been misidentified. It has been generally believed for many years that the Gray whale is approaching extinction and until the winter of 1924 no especial effort was made to conduct whaling operations on its breeding grounds along the coast of Lower California. Floating factories working in that area reported a catch of 140 Gray whales in 1925, a total of 42 in 1926, a total of 29 in 1927, a total of 9 in 1928, and only 2 in 1929. Sperm whales rarely come within the fields worked by the whaling companies operating off Lower California and California in so far as one can judge from the yearly returns of the Pacific Coast whaling companies, but during their migrations they frequently approach the shores of Vancouver Island and the Aleutian Islands. Very few Right whales have been caught by the Pacific stations, and, with the exception of one killed by a Vancouver company, all were taken in the Alaska field. In 1919, 1920, and 1921 a number of White whales or Belugas were taken by the Alaska stations.

Generally speaking, in the southern hemisphere the Humpbacks, Finbacks, and Blue whales leave the Antarctic polar seas in the autumn, pass the winter in the Tropics, and return to the Antarctic feeding grounds in the spring. Since the seasons are reversed in the northern hemisphere, these same kinds of whales leave the Tropics in the spring or early summer, journey to the Arctics before the summer is far advanced, and commence their southern migration in late fall or summer. These migrations are rather closely connected with the breeding habits of the species.

The data assembled by the staff of the Marine Biological Laboratory[1] at King Edward's Point, South Georgia, including the measurements and correlated biological investigations of 1683 whales of which there were 785 Blue, 792 Finbacks, 73 Sei, 24 Humpbacks, 3 Right, and 6 Sperm whales, indicate that the nursing period in the Blue whale lasts for about seven months, while the young Finback is weaned in about six months. A Blue whale 23 ft. long at birth, which is weaned when it reaches an average length of 52 ft. 6 in., attains a length of approximately 59 ft. by the end of the first summer south, 68 ft. 11 in. by the close of the second summer south, and reaches sexual maturity the second winter north when the males average 74 ft. 2 in. and the females 77 ft. 9 in. A Finback 21 ft. 4 in. long at birth, which is weaned when it reaches an average length of 39 ft. 4 in., becomes sexually mature at 63 ft. 8 in. in case of males and 65 ft. in case of females. It is unfortunate that no effort has been made to assemble sufficient data on the bodily proportions of whales taken at the several Pacific Coast stations for an intelligent interpretation of the catch in that region. From A. Brazier Howell I have received the measurements of 16 male and 15 female Finbacks taken at Trinidad, Calif., during May, June, and July, 1926. For this small series the

[1] Mackintosh, N. A., and J. F. G. Wheeler, Southern Blue and Fin Whales, with Appendices by A. J. Clowes. Discovery Reports, Cambridge, vol. 1, pp. 257–540, pls. 25–44, figs. 157. November, 1929.

average length of the males is 59 ft., and that of the females 65 ft. 7 in. The largest male taken measured 67 ft. in length and the smallest 40 ft. The largest female was 73 ft. long and the smallest 52 ft. On the basis of the data secured in the southern hemisphere, fully three-fourths of all male Finbacks taken at Trinidad were sexually immature, and nearly one-half of the females were sexually immature. During the above mentioned period at Trinidad, Calif., 8 male and 10 female Humpbacks were taken. The average length of the males was 37 ft. 9 in., and that of the females 39 ft. 7 in. The largest males and females measured 48 ft. and 46 ft., respectively, and the smallest males and females 29 ft. and 33 ft. 6 in., respectively. According to the figures published by Hinton,[2] the average length of sexually mature male Humpbacks at different localities is 44 ft. (near Finmark); 48.8 ft. (off the British Isles); 39.6 ft. (off Newfoundland); and 44.13 ft. (at South Georgia). For sexually mature females Hinton gives the following measurement: near Finmark, 47 ft.; off the British Isles, 45 ft.; off Newfoundland, 46 ft.; and at South Georgia, 46.66 ft. These figures suggest that the Trinidad, Calif., catch was largely composed of sexually immature animals.

In the exploitation of any natural resource, the practice of obtaining the largest possible returns without regard either to methods employed or to the depletion of the stock by wasteful processes is almost invariably followed. Unlike inorganic resources, such as minerals and precious stones, animals and plants are capable of reproducing themselves, and if wisely conserved will yield an adequate return indefinitely. Fortunately, therefore, at the present time many of the leaders in the whaling trade are coöperating in an effort to determine the biological factors that are involved. The data thus far obtained substantiate the claim that the present rate of killing is far in excess of the normal rate of reproduction and that the catch should be regulated. From an economic point of view the excessive slaughter of any kind of whale is folly and the killing of calves and lean whales in tropical waters is clearly wilful waste of one of our most important natural resources. There is no legitimate excuse for conducting whaling operations in tropical waters where the whales are so lean that little profit can be expected, or for the killing of females accompanied by young. The past history of whaling is all too well known, but the future still lies before us. It would seem the part of wisdom to profit by the mistakes of the past and to conserve the animals that are the basis for this great industry.—Remington Kellogg.

EARLY TRADE VALUE OF SKINS IN MONTANA

Recently I made the acquaintance of Mr. A. R. Eisley of Auburn, California, who was in the vicinity of Fort Benton, Montana, in 1872, and he has told me of some of the then current trade values of various skins. The prices paid by the traders follow: A good buffalo robe—3 small tin cups of sugar, 2 small tin cups of coffee, or 1 ten pound can of flour. A wolf skin—2 cups of sugar. A coyote skin—½ cup of sugar. A beaver skin—½ cup of sugar.

Mr. Eisley says that he has known an Indian to trade a good robe for a 25-cent butcher knife, and another robe for a little 10-cent file to sharpen the knife.

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[2] Hinton, M. A. C., Reports left by the late Maj. G. E. H. Barrett-Hamilton relating to the whales of South Georgia. London, pp. 56–210, with 1 table. [p. 73] 1925.

Licensed traders paid white trappers five dollars for a buffalo robe, three dollars for a wolf skin, and one dollar and fifty cents for a coyote skin. In 1868 buffalo robes were being sold in eastern communities at twelve to fifteen dollars apiece.—TRACY I. STORER, *University Farm, Davis, Calif.*

CALENDAR OF DISAPPEARANCE AND EMERGENCE OF SOME HIBERNATING MAMMALS AT WELLS RIVER, VERMONT

Wells River, where the following observations were made, is located in the Connecticut Valley, some seventy miles south of the International Boundary. Owing to the low altitude of the valley at this point, the climate is milder than that of the country on either side a few miles back. The fauna is that of the Transition zone with a slight admixture of Canadian.

The data tabulated below are the result of three years of observation, except in the case of one species, the Skunk, *Mephitis nigra*, for which there is a record of four years. The dates given of disappearance and emergence are the dates when an individual of the species was last or first seen, and as the observer was with few exceptions daily in the field, they are approximately correct.

The average dates of disappearance for the several species with earliest and latest records for the period are as follows:

Skunk, *Mephitis mephitis nigra*—Average, Nov. 12; earliest, Nov. 9, 1926; latest, Nov. 21, 1925. Woodchuck, *Marmota monax preblorum*—Average, Sept. 19; earliest, Sept. 16, 1926; latest, Sept. 22, 1928. Chipmunk, *Tamias striatus lysteri*—Average, Oct. 24; earliest, Oct. 14, 1928; latest, Nov. 1, 1927.

The times of emergence follow: Raccoon, *Procyon lotor lotor*—Average, March 16; earliest, March 10, 1927; latest, March 25, 1926. Skunk, *Mephitis M. nigra*—Average, March 4; earliest, Feb. 27, 1928; latest, March 17, 1926. Woodchuck, *Marmota monax preblorum*—Average, March 23; earliest, March 13, 1927; latest, April 5, 1928. Chipmunk, *Tamias striatus lysteri*—Average, March 21; earliest, March 11, 1927; latest, March 27, 1928.

The average daily maximum and minimum temperatures for one week preceding the emergence of each species were as follows: Raccoon, *Procyon l. lotor*—1926: Maximum, 42.14 degrees; minimum 20.57. 1927: Maximum 34.57 degrees; minimum 21. 1928: Maximum 33.71 degrees; minimum 11.71. Skunk, *Mephitis M. nigra*—1926: Maximum 30 degrees; minimum 6.14 below zero. 1927: Maximum 36.28 degrees; minimum 22.42. 1928: Maximum 19.28 degrees; minimum 9.57. Woodchuck, *Marmota monax preblorum* 1926: Maximum 40.28 degrees; minimum 14.28. 1927: Maximum 46 degrees; minimum 26.85. 1928: Maximum 42.57 degrees; minimum 24.57. Chipmunk, *Tamias striatus lysteri*—1926: Maximum 42.14 degrees; minimum 20.50. 1927: Maximum 41.57 degrees; minimum 21.57. 1928: Maximum 45.28 degrees; minimum 28.71.

There is apparently no close correlation between temperature and resumption of activity. Perhaps the depth of snow had something to do with the late emergence of the Skunk in 1926, there being nearly three feet on the ground as late as March 10th. On the other hand, snow disappeared days ahead of the first appearance of Woodchucks and Chipmunks in 1928. Quiescence is not complete in all these species, for a Chipmunk was seen Dec. 13, 1926 and one or more Skunks become active during almost every thaw throughout the winter.

The period of inactivity of one Chipmunk was determined during the season

of 1927–1928. It was actively collecting food, in this case seeds from a sugar maple (*Acer saccharum*), during several days preceding its disappearance on October 10. A few leaves were placed over the mouth of the burrow and weighted with coarse twigs. These were not disturbed until April 5, 1928. This indicates an individual variation of at least three weeks in the time of disappearance. Similar variations are noted in the case of Woodchucks. About September first, the species is less often seen and soon several days pass without one being seen. The time of emergence likewise differs among individuals, but does not cover so long a period.—WENDELL P. SMITH, *Wells River, Vt.*

RECENT LITERATURE

Phillips, John C. AMERICAN GAME MAMMALS AND BIRDS: A CATALOGUE OF BOOKS, 1582 TO 1925. SPORT, NATURAL HISTORY AND CONSERVATION. Houghton Mifflin Company. 8vo., pp. 1–639. Cloth, $10.00. 1930.

We have learned to expect of Dr. Phillips books that are distinctly worthwhile and the present volume maintains the high standard set by his other contributions, in accuracy, composition, and general style.

At present, when the volume of papers on any one subject is so large and scattered that the busy individual despairs of covering his chosen field with thoroughness, a comprehensive, annotated bibliography often proves to be a contribution more valuable than one based upon other research would be. And the present volume appears at an opportune time when an increasing amount of attention is being given to the welfare of our waning supply of avian and mammalian game.

The subject matter is presented under three headings, the first of which, covering 418 pages, comprises titles arranged by authors. Regarding the extent and scope of this part we are told that it includes a list of works and separates dealing in whole or in part with the subject of North American game mammals, fur mammals, upland game, wild fowl and shore birds. A nice degree of discrimination has, of course, been necessary in including, or excluding, titles covering other subjects mainly, with game treated only incidentally. It has seemed advisable, we are told, to exclude for the most part purely technical works on ornithology and mammalogy, accounts of the early fur trade, and Arctic sport. On the other hand, works on the fur seal, the more important titles covering ballistics, hunting dogs and those on camp lore, are included. As one turns the pages he is greeted by many old friends among the titles which stimulated and thrilled most of us in our earlier days.

Part two, covering 155 pages, is divided between general, federal, and state conservation, and conservation in Canada. The scope of this portion is surprising, including as it does references to game laws, the publications of national organizations and federal commissions, conventions, regulations, executive orders and similar items in such great variety as to delight the heart of any one concerned with conservational investigations.

The third part, of 64 pages, is an annotated list of periodicals, many of them obscure and of amateur status, taken, for the most part, from the publication on

this subject by Frank L. Burns (1915), and hence repeating at least some of the occasional errors made by Mr. Burns. It seems to the reviewer that too much space is devoted here to some of the more obscure publications of extremely evanescent life and questionable worth while others, such as the Auk with its three lines, merit fuller treatment. But this is a debatable and very minor point. The sole impression left upon the reader is of a thoroughly worth-while undertaking well done.—A. BRAZIER HOWELL.

Sheldon, Charles. THE WILDERNESS OF DENALI. New York-London: Charles Scribner's Sons. 8vo., pp. XXV + 412, frontispiece (portrait of author) 111 illus. in text, and map. Cloth $6. 1930.

In this posthumous work by the hunter-naturalist author of "The Wilderness of the Upper Yukon" are recounted the experiences of two trips to the Mount McKinley region of Alaska, the first in 1906 and the second in 1907–1908. The introduction, a character sketch of the author, is by C. Hart Merriam, and the manuscript was edited by him and by E. W. Nelson.

The mountain sheep and the grandeur of their usual habitat aroused in Charles Sheldon the keenest interest, and appealed most strongly to his imagination, although he was a hunter of many kinds of game and a student of wild life in general. After several hunting seasons, in Northern Mexico, Yukon Territory and other regions with sheep as the principal objective, he decided to study the sheep of the northern slopes of the great Alaska Range in the vicinity of Mount McKinley, called "Denali" by the Indians, the highest mountain on the continent. A summer trip with pack horses in 1906 to this region was successful and replete with interesting experiences. Sheldon was so impressed with the inadequacy of a single season's observations, however, that he determined to return prepared to spend the winter and thus extend his investigations of the life history of the white, or Dall sheep, through the entire year. Accordingly he revisited the region the following year and remained from July, 1907 until the middle of June, 1908. A cabin was built near timberline in the heart of the sheep country, on the upper part of the Toklat River, and used as a base camp. Sheep on the surrounding mountains were often visible from the cabin, and by making daily excursions, or establishing temporary camps in other localities, the various bands of these animals in the general region were kept under frequent observation at short range.

While the primary interest of the author was in the sheep, the other large game of the country, the moose, caribou, and bears as well as the wild life in general, received attention. The account consists largely of dated entries from his journals, detailing with meticulous care his experiences and observations in stalking, shooting, photographing, and studying animals. The volume embodies comprehensive observations on the wild life as a whole, tracing the progressive seasonal changes in habits and the relation of species to one another, which with his varied experiences and animated descriptions of the country combine to form a narrative of absorbing interest. Among the many subjects treated are the popular notion that mountain sheep post "sentinels" to protect the band. The author discredits this belief, stressing, however, their keenness of vision, whereas the caribou and bears exhibited as more characteristic their remarkable ability to scent danger. Breeding habits, the fighting of rams and bull caribou for possession of the females, the shedding of antlers, the hibernation of bears, and inroads

of certain predatory animals are dealt with in detail. Lynxes were found disabling and killing sheep by tearing out their eyes. Evidence that golden eagles prey upon the very young lambs appeared to be conclusive. Ravens were abundant early in the winter, but became progressively scarcer and all disappeared toward spring. Two trappers using strychnine for foxes in the valleys below informed the author that they found nearly 200 ravens dead from poison, and were unsuccessful in poisoning foxes until the ravens were practically exterminated. Then they killed more than sixty foxes. This, apparently, is an example of how the unwise use of poison may result in the virtual elimination of valuable fur bearers.

Few such yearlong studies of the wild life of a particular area have ever before been made by a hunter-naturalist, at least in America, and the result is a mass of new information available nowhere else. The author was so impressed by the magnificance of Denali and the adjacent Alaska Range, with its abundant wild life, that some years later he initiated steps leading to the establishment of Mount McKinley National Park. His observations, made while the region was still essentially unmodified by human invasion, and before the creation of the Park, will be of especial value in checking conditions affecting the wild life in the future.

Sheldon's field investigations evidently were pushed with the utmost vigor. Day after day or in the darkness of the Arctic night, often in severe weather, and at considerable risk of his life, he climbed precipitous mountains, forded icy and at times torrential streams, or penetrated to the most inaccessible places in quest of game or some particular information. On returning to camp, often carrying game and nearly exhausted from prolonged exertion he recorded the events of the day before he slept. Only a man of unusual strength and hardihood could have withstood such hardships.

During much of the time the author had as companion his camp man, Henry Karstens, afterward the first superintendent of Mount McKinley National Park, from whom he parted "not without sincere regret." He hunted alone, however, and found in solitude the greatest inspiration. There are many vivid descriptions showing his keen appreciation of form and coloring, and revealing the depth of his feelings in contemplating wild mountain scenery. A winter picture with caribou in the foreground is drawn as follows: "There they stood in the snowfields of the ridges where the rosy hues of the sky were reflected on the snow, and behind them towered the stupendous background of Denali. During such moments, if one loves the wild sublimity of the mountains and the presence of wild game animals, he feels profoundly the haunting mystery and isolation of the deep recesses of the unknown wilderness and is consumed by a happiness so intense that not even the imagination of a poetic genius could adequately express it."

In the contemplation of nature and reflection in solitude there come periods of exaltation when the mind functions untrammeled by the distractions and prejudices which seem inseparable from the usual human contacts. At such times things assume truer proportions, and then, if ever, there is accurate appraisal of men and events. Those who knew Charles Sheldon were impressed by his broad grasp of the many problems of wild life. His clear conceptions, we may now believe, were largely the result of long reflection in solitude, among the mountains he loved. The book ends with a plea for the restoration of the Indian names "Denali" (the high one) for Mount McKinley and "Sultana" (his wife) for Mount Foraker ". . . . the former more sublime perhaps than any other mountain in the world."—E. A. Goldman.

Akeley, Mary L. Jobe. CARL AKELEY'S AFRICA. New York: Dodd, Mead and Co., 8vo, pp. xix, 1-321, 82 illus., 5 maps, cloth, $5.00, 1930.

Those who read this book will truly thank Mrs. Akeley, as we may say, for taking them behind the scenes and giving them an insight into the activities of the natives who were met in the various regions visited, of the wild life coming under observation, and of the scenery along the ever-changing route, all contributing to form a well balanced narrative full of valuable data that should appeal alike to the naturalist, sportsman and layman.

The tales of across the Uganda, into the Congo, or on Mt. Mikeno keep the readers right with the party to share their thrills, or to admire their patience and perseverance when hardships, difficulties and dangers befall them as almost everyday occurrences.

The chapter on old African Trails gives a pleasing account of the country; but sadness comes when we learn that only a small remnant of the wild animals now remain where once countless numbers roamed, all due to the exterminating influence of the white man.

The reviewer is sure that those who have read of the capture of giraffes, buffaloes and other animals after hard and long distances traveled, the long hours of tedious waiting and arduous work in preserving the material after it has been secured, will more fully appreciate the wonderful exhibits in the halls of the American Museum.

The few only who have had similar experiences know the amount of time and care taken in making photographs and sketches so that groups when completed will have a natural surrounding as if a part of the country had been moved in to make the exhibit complete.

The wonderful experience which the party had with the friendly lions must be a marvel to those who have in mind the lion only as a killer or one that is ever on the defensive.

When they come to the account, those with a speck of sportsman's spirit, at least, will have a shade of envy when they read of the authoress killing the finest specimen of lion seen throughout the whole expedition.

All those who are saddened by the thought of the passing of African wild life through wanton destruction will take heart when they read of the wonderful country in which Albert the Gracious King of Belgium established the Parc National Albert, for the much needed protection of the mountain gorilla, and other forms of animal life inhabiting the area.

The diversified topography, including extinct volcanoes with their heavily wooded slopes, the low sandy plains and swamps, Lake Edward and Rutshuru River furnishing an abundant supply for aquatic forms, makes it an ideal home not only for the gorilla but also for the elephant, buffalo, antelope, hippopotamus and some of the carnivores, which naturalists and nature lovers feared would soon be known only as museum specimens or as illustrations in works of natural history.

All of this is described in the book in interesting detail which coupled with the fine illustrations gives the reader a clear idea of the immense value as a big game sanctuary of this far-off section secured through the supreme efforts and untiring advocacy of Carl Akeley.

Not only does this inviolate sanctuary give protection to animal life but it forbids the despoiling of the native flora under penalty of penal service, or fine,

or both. The wonderful array of majestic trees with their ever varying foliage of tints and shades of green, that cover the slopes of the three volcanoes, Mikeno, Bishoke and Karisimbi, not only enthuse the botanist and nature lover, but are sure to allure the artist whose eyes are ever ready for the attractive and the beautiful.

Through Carl Akeley's inspiration and the farsightedness of the King, to Belgium is due the honor of establishing the first real sanctuary for the protection of wild life in Africa. If this example should be followed in the near future by other European countries holding concessions in the dark continent, and selected areas are set aside for all time for the preservation of animal life, there would seem to be good reason to hope for the continuance of the larger mammals which now appear in danger of extinction.

One very commendable thing to be found throughout the work relative to the Sanctuary from its inception to its realization, as well as in other parts, is that credit is given where credit is due. It seems very pertinent to bring up this point because just acknowledgment is a virtue which is often forgotten by many authors and lecturers. Many interesting facts that appear in their writings or their lectures would never have come to light but for the assistance given by the unknown and silent co-author. Some of the wonderful moving pictures of lions and other African animals that have been so entertaining to the multitude in this country never would have appeared but for Akeley's willing assistance.

Our devoted friend gave his all to accomplish this wonderful piece of conservation, and to give to his country a most marvellous exhibit of the African fauna. May we and the coming generations keep this firmly in our minds, and show our full appreciation of the good he has done for wild life, and for the education of his fellow men.—A. K. Fisher.

Seton, Ernest Thompson. Game Animals and the Lives They Live. Garden City, New York: Doubleday, Doran & Company, Inc. 4 volumes: 50 maps and 1,500 illustrations. Pp. xxxix, 640; xvii, 746; xix, 780; xxii, 949. 1925–26–27–28. Reissued in 8 parts with original pagination and illustrations. 1929. Price of later edition, $40.00.

Some years ago Seton issued his "Life Histories of Northern Animals" a two volume work which contained detailed accounts of the mammals of Manitoba, the scope extended to take in all species closely related to those inhabiting the province itself, and thus including most of the land mammals of the northern half of the continent. This work introduced a new scheme in the literature of mammal life-histories, an account that treated the life and doings of the subject under a large number of classified headings, a method that spurs the author to search out all the available facts, and helps the reader to find quickly the particular kind of information he seeks.

Ever since 1909, the students of our mammals have been waiting for a set of volumes, worked up along similar lines, but covering all of North America. This need the author wished to fill, but felt unable to cover the entire field in the thorough manner that the subject demanded. He therefore concluded to confine his field to those groups that command the widest interest, the Game Animals. The scope of the work under review covers, to quote from the title page, "Those land animals in America, north of the Mexican border, which are considered game, either

because they have held the attention of sportsmen, or received the protection of law." Those species taken for their fur are of course included.

Unfortunately for the general student, the original edition, which was issued between 1925 and 1928, a volume appearing each year, was limited to one hundred and seventy-seven, and this limited number of sets, and the price that they naturally commanded, was a serious handicap to the use of the material, however necessary or expedient was the limitation. But a larger and less expensive edition was early promised, and all lovers of wild life were glad to see this promise fulfilled, in 1929, by the appearance of a new issue. This is in eight parts, of a size slightly smaller than the original edition. The pagination, illustrations, and type bed, however, are the same, the original number of volumes being retained by the expedient of dividing each into two parts. The new edition, therefore, may be quoted with assurance as to volume and pagination.

The author of this series of volumes, depicting with pen and pencil the lives of our American mammals, needs no introduction to American mammalogists, or to students of any branch of wild-life lore. As a popular lecturer and writer he has been in the fore-front for many years. There are few types of country from our southern border to the treeless plains of northern Canada where he has not studied at first hand the life of mountain, plain, and waterway. And always, in youth or maturity, he has sought for the truth about animals, to piece together what he calls the great mosaic—the lives of our mammals as they were lived before the devastating hand of man came into their haunts. Always he has sketched with a skill probably not excelled by any mammal artist of our time, and always he has brought back from his outings, whether extending for days or months, his well-filled notebooks. From these, and numberless notes gleaned from all sources, by word of mouth and from the printed page, he has constructed this monument, a work that deserves a place in all libraries, public or private, that serve the devotees of our wild life, past, present, or future.—Edward A. Preble.

Gregory, Tappan. Deer at Night in the North Woods. Springfield, Ill., and Baltimore, Md.: Charles C. Thomas, 8 vo., pp. XIV; 211. Frontispiece, 45 illus. (including one map). Cloth, $4.00. 1930.

Many have discarded the gun for the camera in the pursuit of game animals, but this book is the record of one who began with the camera, and has never taken up the gun. With the exception of a few habitat pictures, and four pictures of the moose in New Brunswick, the subject of the closing chapter, and a map of part of the Upper Peninsula of Michigan, all the 45 pictures are of white-tailed deer, and all of these were taken at night.

The history of the growing interest of the author in photographing the white-tailed deer of Michigan, and of the struggles and experiments and disappointments that finally resulted in many successes, is told with clearness and feeling. Since the author's own experiences have been largely confined to the summer months he has compiled from reliable sources a very readable account of the life habits of our eastern races of white-tailed deer. Credit in detail is given for these notes, which form the bulk of the opening chapter, and also for the skillful coöperation of several friends whose company the photographer has shared on many a night of voyaging. Other chapters relate to methods of photography by day and night, and to the reactions of the animals to the strange sounds and actions resulting

from the invasion of their haunts by the photographer, with his boat and flashlight.

The book carries a strong appeal to all who love our northern lake-studded forests, and their wild inhabitants.—EDWARD A. PREBLE.

Bailey, Vernon. ANIMAL LIFE OF YELLOWSTONE NATIONAL PARK. Charles C. Thomas Co., Springfield, Ill. pp. 241, colored plates 4, text figures 66, cloth $4.00. July 20, 1930.

Animal Life of Yellowstone National Park is one of the attractive nature books of the season. The mammals, with interesting accounts of their habits, distribution, and relations to one another and to the human inhabitants, occupy the larger part of the book, but there are also valuable notes on the birds, and briefer references to the reptiles, fishes, insects, and other invertebrates. As the author points out none of these subjects are treated completely nor can they be until the great wild life laboratories afforded by our National Parks are more fully utilized than at present. We are just learning of their incomparable value for studies of our native species in all their multiple forms and complex interrelations. The book, however, shows that a good beginning has been made, and affords also fascinating reading for both naturalist and layman.

The book is beautifully illustrated with two colored plates by O. J. Murie, a family of grizzly bears and the three local forms of rosy finches, the bald eagle in color, by Robert Ridgway, and a life zone map of the Park Region. There are also numerous half-tones of mammals and birds. It is edited by Dr. Hartley H. T. Jackson as one of a series of popular nature books by authors who know their subjects and have the ability to present facts in attractive form.—EDWARD A. PREBLE.

ABROMAVICH, CHARLES E, JR. Uterus and fetal membranes of the Indian antelope (Antilope cervicapra). Anat. Rec., vol. 46, no. 2, pp. 105–124, 12 figs. 1930.

ADLERBERG, G. Preliminary synopsis of Russian and Mongolian wild boars. Comptes Rendus Acad. Sci. URSS., pp. 91–96, figs. 3. 1930. (News: *Sus scrofa raddeanus*.)

ALLEN, G. M. AND HAROLD J. COOLIDGE. Mammals of Liberia. The African Republic of Liberia and the Belgian Congo. Based on the observations made and material collected during the Harvard African Expedition 1926–1927. Cambridge, Harvard Univ. Press, pp. 569–622, figs. 444–453. 1930. (New: *Hylomyscus alleni simus*.)

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COMMENT AND NEWS

REPORTS ON GAME POLICY

It is gratifying to note that the Committee on Game Policy, of which our fellow member Aldo Leopold is Chairman, of the American Game Conference, has made some recommendations in regard to wild life that follow the tenets of thoroughly sound conservation. In a pamphlet just issued (November), entitled "A Proposed American Game Policy to be Discussed at The Seventeenth Annual American Game Conference" a keen analysis, in outline form, of the present situation is presented, and facts are squarely faced. It is even recognized that game species have a value when considered and treated as non-game, and that it might be more desirable to abolish the hunting of a threatened species entirely than completely to exterminate it. It is also encouraging to note that species that are at times predaceous are conceded to merit consideration. In regard to the latter it is recommended among other things, that "No public agency should practice control in any region without establishing adequate fact-finding service in that region." "Each public agency engaged in predator-control should seek periodic review of its policy and operations by some independent scientific body without administrative or financial interest in control work? and the "Use of poison, bounties, national advertising, organized competition, or other methods unlikely to discriminate between species or between varying local conditions should be resorted to only in emergency or under careful safeguards." If this publication is an indication of present trends in game matters there is still some reason to be hopeful for the preservation of our wild life.—A. B. Howell.

RESOLUTIONS OF WESTERN ASSOCIATION OF STATE GAME AND FISH COMMISSIONERS NOVEMBER 1, 1930

Whereas, reliable scientific data on the effects of predatory animal poisoning in different parts of the West is meagre and conflicting; now, therefore,

Be It Hereby Resolved, that the Western Association of State Game and Fish Commissioners, in regular session assembled in Santa Fe, New Mexico, this 16th day of September, 1930, does hereby favor the appointment of a commission of scientists with open minds on the question at issue, to investigate, (1) the diet of the coyote in all parts of the country and at all times of the year; (2) the numbers and kinds of fur-bearing animals, game animals, and game and non-game birds destroyed in different parts of the country by poison; and (3) that further expansion of predatory animal poisoning be postponed pending the outcome of this investigation.

—(Sponsored and introduced by Clinton W. Rowley (Washington) and unanimously adopted.)

Whereas, the bear is a noble sporting animal deserving of protection in all except the comparatively few cases in which he becomes a habitual stock-killer; now, therefore,

Be It Hereby Resolved, that the Western Association of State Game and Fish Commissioners, in regular session assembled in Santa Fe, New Mexico, this 16th day of September, 1930, does hereby urge greater protection for the bear, and condemns its killing by federal predatory animal hunters, except as a remedy in extreme cases; and

Be It Further Resolved, that this Association does hereby urge the government to seriously consider a plan whereby certain parts of the Alaska Peninsula shall be set aside as sanctuaries (with limited hunting only) for that most magnificent of North American animals, the brown bear of Alaska.

—(Resolution 8. Sponsored and introduced by Roland G. Parvin (Colorado) and unanimously adopted.)

PROGRESS REPORT OF COMMITTEE ON PROBLEMS OF PREDATORY MAMMAL CONTROL

After correspondence with the Chief of the Bureau of Biological Survey and the tender by the Committee of coöperation with the Survey, a working plan was suggested whereby the Committee was to send representatives into the field to conduct joint investigations with Survey officials.

The Committee, through the generous support of various institutions and individuals, was able to command sufficient funds and personnel to take an active part in the field investigations, which began in November. The Committee has had five field investigators gathering data at critical points in the West and is already in possession of many valuable data.

Dr. E. Raymond Hall has been at work upon some of the problems in California. Professor C. T. Vorhies has been conducting a lengthy investigation with Dr. W. P. Taylor of the Survey in Arizona, New Mexico and Texas. Mr. E. Lowell Sumner, Jr. represents the Committee and the California Fish and Game Commission in California, and has investigated jointly with Mr. E. A. Goldman of the Survey. Mr. G. G. Goodwin of the American Museum was the Committee field representative for Idaho and Utah, and worked in concert with Messrs. Goldman and Locke of the Survey. Mr. T. D. Carter, also of the American Museum, has been acting for the Committee in viewing the problems created by Survey poisoning as they affect the trappers and raw-fur traders. A part of the funds were donated by the western fur dealers to pay for such an investigation, and Mr. Carter has directed his itinerary to include regions of vital importance to the trappers.

Among the institutions actively supporting the Committee are the American Museum of Natural History, the New York Zoological Society, the University of Michigan, the California Fish and Game Commission, the California Museum of Vertebrate Zoology, and the University of Arizona.

Many individuals have communicated with the members of the Committee or the field representatives, with the result that well over a thousand recorded contacts have been established, possibly several times that number when all reports are in, and the Committee is happy to report a very widespread sentiment to aid the investigation.

A CHAT WITH AUTHORS

Through experience we are familiar with the snares that beset the path of mankind, both in the rôle of author and that of editor. We will refer now only to the peculiarities of the English language as regards spelling and grammar. That these natural difficulties are augmented by the vagaries and the total depravity of the typewriter is also well known, not to mention the sinister influence of the scratchy pen, the weak pencil, and other agencies still under little control. But

for your own sake, and in behalf of the editor, try to spell correctly or as nearly so as possible. Use the dictionary if necessary. This will lighten our task and help you; many of the technical words that the author may wish to print we do not know how to spell, ourselves. (We forgot punctuation, so will not mention it.) Try to say what you mean; if you fail in this, the editors and the world may never hear your message. After all, it is your article; the editors are all busy people, and may even have secret yearnings to find time to be authors themselves. Avoid tabular matter as much as possible; it is expensive. Confine yourself to the subject matter; your hopes and fears and wonderings may seem interesting to you, but they seldom are to the reader. Be brief, but not at the expense of clearness. When reading proof remember that the days when the time of the printer was not valuable, and editing could be done on the galley, are over. Printers are now exceedingly able bookkeepers and charge well even for small changes. The editors are trying to conserve the funds of the society, and are thinking of passing some of these charges on to the author.

Remember that illustrations cost money and time, and submit only those that are necessary, and good. The cost of a plate about equals 8 years' dues; of a page of tabular matter, about 3 years'. In the preparation of illustrations let as many as possible be drawn or mounted on paper the size of the manuscript page; the rate of reduction necessary to admit the plate or line drawing to the printed page of the journal does not call for an excessively large plate. Illustrations must be handled, packed, and transported; it they are larger than necessary, an additional burden is placed on the editor, for they must make several journeys after they reach him.

These remarks are inspired by the fact that during the past few months we have handled, and attempted to edit, sometimes with the collaboration of the author, and with varying success, some of the most carelessly prepared manuscripts that have come to our attention in the course of a long experience. Perhaps the overuse of the midnight bulb is beginning to react unfavorably on us, but on the whole we are trying to be fair to the society, to the author, and to ourselves.

Though these remarks are informal, and possibly may sound facetious, they have been carefully considered, and we mean every word of them.

ANNOUNCEMENT OF ANNUAL MEETING

The thirteenth annual meeting of the American Society of Mammalogists will be held at the Academy of Natural Sciences, Philadelphia, Pa. from May 12 to 16, 1930. Headquarters will be at the Robert Morris Hotel. Titles and further particulars regarding papers for presentation should be in the hands of the Corresponding Secretary not later than April 20, and it has been deemed necessary to limit the length of delivery to twenty minutes, save in the case of special features employing motion pictures. Authors are requested to make certain that this time will not be exceeded. Further details regarding the meeting may be obtained from the Corresponding Secretary, or from the Local Committee on Arrangements: JAMES A. G. REHN, *Chairman*, WHARTON HUBER, HENRY R. CAREY.

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Department of Anatomy, Johns Hopkins Medical School, Baltimore, Md.

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